

4420

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: 9/30/14

SUBJECT: QAPP REVIEW REQUEST

FROM: Michael Bernoff

PHONE: 389 83

TO: TIM PRENDIVILLE, CHIEF
REMEDIAL RESPONSE SECTION 2

Attached please find _____ copies of a QAPP for your review.

SITE NAME: USS Lend

STATE: IN

LEAD: FUND ☒ PRP ☐ STATE ☐

SITE ACCOUNT# 053JNG02

PHASE/STAGE: RI/FS, (RD) RA OTHER _____

QAPP REVISION NO. 1 (INITIAL REV. IS '0')

QAPP PREPARED BY: SJHRA

PRE-QAPP MEETING? YES ☒ NO ☐ MTG. DATE: _____

REQUESTED REVIEW TIME:

☒ INITIAL REVISION
☐ 1ST REVISION
☐ 2ND REVISION

EXPEDITED REVIEWS WILL NEED A MEMO FROM BRANCH CHIEF

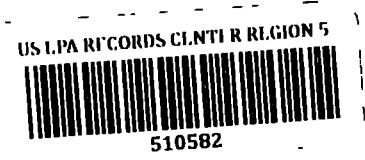
ENCLOSURE/OTHER DOCUMENTS:

☒ WORKPLAN ☒ SAMPLING PLAN ☒ SOPs ☒ SAS

COMMENTS: I can provide docs electronically

TO BE FILLED IN BY RRS 2:

DATE IN _____
DATE DUE _____
FSS LOG-IN NO _____



**REMEDIAL ACTION CONTRACT 2
IN REGION 5**

**ATTACHMENT B
DRAFT QUALITY ASSURANCE PROJECT PLAN
FOR
U.S. SMELTER AND LEAD RESIDENTIAL AREA SUPERFUND SITE
OUI REMEDIAL DESIGN
EAST CHICAGO, LAKE COUNTY, INDIANA**

**Prepared for:
U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 5
77 West Jackson Boulevard
Chicago, IL 60604**

**Prepared by:
SulTRAC**

Date Submitted:	September 22, 2014
EPA Region:	5
Work Assignment No:	198-RDRD-053J
Contract No:	EP-S5-06-02
Prepared by:	SulTRAC
Project Manager:	Richard Baldino
Telephone No:	(312) 443-0550 x26
EPA Work Assignment Manager:	Michael Berkoff
Telephone No:	(312) 353-8983

CONTENTS

<u>Section</u>	<u>Page</u>
B1 0 Introduction.....	1
B2.0 Site Description and History.....	2
B2.1 Site History	2
B2.2 Previous Site Investigations and Removal Actions	3
B3.0 Quality Assurance Project Plan Procedures.....	6
QAPP Worksheet #1 Title and Approval Page.....	7
QAPP Worksheet #2 QAPP Identifying Information.....	8
QAPP Worksheet #3 Distribution List	14
QAPP Worksheet #4 Project Personnel Sign-Off Sheet.....	15
QAPP Worksheet #5 Project Organization Chart.....	16
QAPP Worksheet #6 Communication Pathways.....	17
QAPP Worksheet #7 Personnel Responsibilities and Qualifications Table	19
QAPP Worksheet #8 Special Personnel Training Requirements Table	20
QAPP Worksheet #9 Project Scoping Session Participants Sheet	22
QAPP Worksheet #10 Problem Definition.....	23
QAPP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements	24
QAPP Worksheet #12 Measurement Performance Criteria Table	26
QAPP Worksheet #13 Secondary Data Criteria and Limitations Table.....	28
QAPP Worksheet #14 Summary of Project Tasks	29
QAPP Worksheet #15 Reference Limits and Evaluation Table	31
QAPP Worksheet #16 Project Schedule/Timeline Table	32
QAPP Worksheet #17 Sampling Design and Rationale	33
QAPP Worksheet #18 Sampling Locations/IDs, Sample Depths, Sample Analyses and Sampling Procedures Table.....	42
QAPP Worksheet #19 Analytical Methods, Containers, Preservatives, and Holding Times Table.....	43
QAPP Worksheet #20 Field Quality Control Sample Summary Table	44
QAPP Worksheet #21 Project Sampling SOP References Table	46
QAPP Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table	47
QAPP Worksheet #23 Analytical SOP References Table	48
QAPP Worksheet #24 Analytical Instrument Calibration Table.....	49
QAPP Worksheet #25 Analytical Instrument and Equipment Maintenance Testing, and Inspection Table	50
QAPP Worksheet #26 Sample Handling System	51
QAPP Worksheet #27 Sample Custody Requirements	52
QAPP Worksheet #28 QC Samples Table.....	55
QAPP Worksheet #29 Project Documents and Records Table	57
QAPP Worksheet #30 Analytical Services Table	58
QAPP Worksheet #31 Planned Project Assessments Table	59
QAPP Worksheet #32 Assessment Findings and Corrective Action Responses.....	60
QAPP Worksheet #33 QA Management Reports Table.....	61
QAPP Worksheet #34 Verification (Step I) Process Table	62
QAPP Worksheet #35 Validation (Steps IIa and IIb) Process Table	63
QAPP Worksheet #36 Validation (Steps IIa and IIb) Summary Table	64
QAPP Worksheet #37 Usability Assessment	65
REFERENCES	67

FIGURES

- B-1 SITE LOCATION MAP
- B-2 USS LEAD RESIDENTIAL AREA ZONES

Attachment

- A STANDARD OPERATING PROCEDURES

ACRONYMS AND ABBREVIATIONS

%D	Percent difference
%R	Percent recovery
$\mu\text{g/L}$	Microgram per liter
μm	Micrometer
AES	Atomic emission spectroscopy
ASTM	ASTM International (formerly American Society for Testing and Materials)
bgs	Below ground surface
CA	Corrective action
CaCO_3	Calcium carbonate
CADRE	Computer-aided data review
CAMU	Corrective Action Management Unit
CAS	Chemical Abstract Services
cc	Cubic centimeter
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Calibration factor
CLP	Contract Laboratory Program
CRL	Central Regional Laboratory
CRQL	Contract-required quantitation limit
DQI	Data quality indicator
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
FSP	Field sampling plan
GC	Gas chromatography
HAZWOPER	Hazardous Waste Operations and Emergency Response Standard
HCl	Hydrochloric acid
HNO_3	Nitric acid
ICP	Inductively coupled plasma
ID	Identification
IDEM	Indiana Department of Environmental Management

ACRONYMS AND ABBREVIATIONS (CONTINUED)

L/min	Liter per minute
LIMS	Laboratory information management system
MA	Modified analysis
MCE	Mixed cellulose ester
MCL	Maximum contaminant level
mg/kg	Milligram per kilogram
mL	Milliliter
mm	Millimeter
MRRC	Mining Remedial Recovery Co.
MS	Matrix spike
MSD	Matrix spike duplicate
NA	Not applicable
NaOH	Sodium hydroxide
NC	No criteria
NFG	National Functional Guidelines
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyl
ppm	Part per million
PQO	Project quality objective
PRG	Preliminary remediation goal
PTFE	Polytetrafluoroethylene
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
QL	Quantitation limit
RAC	Remedial Action Contract
RI	Remedial investigation
ROD	Record of Decision
RPD	Relative percent difference
RRF	Relative response factor
RSCC	Regional Sample Control Coordinator
RSD	Relative standard deviation

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SAP	Sampling and analysis plan
SMO	Sample Management Office
SOP	Standard operating procedure
SOW	Statement of work
SPLP	Synthetic precipitation leaching procedure
SVOC	Semivolatile organic compound
SW	Solid waste
TAL	Target Analyte List
TBD	To be determined
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching procedure
TCRA	Time-critical removal action
UFP	Uniform Federal Policy for Implementing Environmental Quality Systems
USS Lead	U.S. Smelter and Lead Refinery Superfund Site
WA	Work assignment
WAM	Work assignment manager
XRF	X-ray fluorescence

B1.0 INTRODUCTION

SulTRAC has prepared this quality assurance project plan (QAPP) as part of the sampling and analysis plan (SAP) for the U.S. Smelter and Lead Refinery, Inc. (USS Lead) Superfund Site in East Chicago, Lake County, Indiana, under the U.S. Environmental Protection Agency (EPA) Remedial Action Contract (RAC) 2 for Region 5, Contract No. EP-S5-06-02, Work Assignment (WA) No. 198-RDRD-053J. USS Lead is a Superfund Site because of the presence of documented hazardous substances and releases, particularly lead contamination, at residential properties. The SAP consists of the field sampling plan (FSP) (Attachment A) and this QAPP (Attachment B), which are among the site-specific plans to be prepared under the WA in accordance with Task 1 of the EPA statement of work (SOW) (U.S. EPA 2014).

This QAPP describes the quality assurance (QA) and quality control (QC) protocols, objectives, methods, and procedures to be performed by SulTRAC during the remedial design of operable unit (OU) 1 at the USS Lead Superfund Site. This QAPP, as outlined in the USS Lead work plan (SulTRAC 2014), has been developed to support remedial action decision making. QAPP scoping information directly related to USS Lead was gathered from aerial photographs, site diagrams, previous reports, maps, and other assorted documents that describe operational details and nature and extent of contamination in and around the USS Lead Site.

This QAPP discusses field sampling and analytical criteria for data acquisition throughout the remedial design. Section 2.0 of this QAPP addresses the site description and history, and Section 3.0 discusses the QAPP procedures. The QAPP Worksheets are presented after Section 3.0. References used in preparing this QAPP are listed after the Worksheets, and Figure B-1 is presented after the list of references.

B2.0 SITE DESCRIPTION AND HISTORY

The USS Lead Superfund Site is located approximately 18 miles southeast of Chicago, Illinois, in East Chicago, Indiana (Figure B-1). East Chicago is surrounded by one of the most heavily industrialized areas in the U.S., including steel mills, oil refineries, heavy manufacturing, chemical processing plants, and heavy rail. The Residential Area (OU1) of the USS Lead Superfund Site is primarily a low-income residential area with commercial and light industrial areas nearby.

The East Chicago area has historically supported a variety of industries. In addition to the USS Lead smelting operation, some other industrial operations may have also managed lead and other metals. For example, immediately east of the former USS Lead Facility (OU2), across Kennedy Avenue, is the former DuPont site (currently leased and operated by W.R. Grace & Co., Grace Davison). One of the processes that historically took place at the DuPont site was the manufacturing of the pesticide lead arsenate. On the western edge of OU1, west of Gladiola Street and north of 151st Street, two smelter operations reportedly managed lead and other metals. A 1930 Sanborn Fire Insurance Map identifies the operations as Anaconda Lead Products which was a manufacturer of white lead and zinc oxide and International Lead Refining Company which was a metal-refining facility.

B2.1 SITE HISTORY

The USS Lead Superfund Site is comprised of two Operable Units (OU) (Figure B-1). OU2 is the U.S. Smelter and Lead Refinery, Inc. facility and is located on a 79-acre tract of land in East Chicago, Indiana and includes site wide groundwater. OU1 is made up of nearby commercial, municipal, and residential properties north of OU2 (Figure B-1). The contaminants of concern at the site are lead and arsenic. Land use within the OU1 boundaries is a mix of residential, commercial, and industrial properties. The area also includes schools, churches, playgrounds, parks, and small businesses. While USS Lead was a significant contributor to contamination in the residential area, EPA's investigations indicate that other facilities in the area have also been significant sources of contamination to the residential area.

The USS Lead facility (OU2) is a former lead smelter located at 5300 Kennedy Avenue, East Chicago, Indiana. In 1920, the property at OU2 was purchased by U.S. Smelting, Refining, and Mining, and later by USS Lead. At that time, USS Lead operated a primary lead smelter at the facility. Between 1972 and 1973, the facility at OU2 was converted to a secondary lead smelter, which recovered lead from scrap metal and automotive batteries. All operations at OU2 were discontinued in 1985. Two primary waste materials were generated as a result of the smelting operations: (1) blast-furnace slag and (2) lead-containing dust emitted from the blast furnace stack. (SulTRAC 2012).

In September 1985, the Indiana State Board of Health (ISBH) found USS Lead in violation of State law because lead particles were found downwind of the site in the residential area north of the facility (OU1). Approximately four million people draw drinking water from intakes primarily into Lake Michigan, which is 15 miles downstream of where hazardous substances from the site enter surface water. Seventy-five hundred people work or attend school within two miles of the site (SulTRAC 2012).

As part of a RCRA Corrective Action in 2003 and 2006, EPA conducted soil sampling in OU1. In the 2003 EPA RCRA investigation, eighty-three residential properties within OU1 were sampled and analyzed for lead using a Niton X-ray fluorescence (XRF) instrument in late July and early August 2003. Soils from 43 locations (52 percent) exceeded the 400 mg/kg residential soil screening criterion for lead. On January 22, 2008, EPA approved a time-critical removal action for private residential properties within OU1 due to elevated levels of lead in surface soils identified during investigations conducted from 2002 through 2007. EPA identified 15 private properties that contained soil with lead concentrations exceeding the “regulatory removal action level” of 1,200 mg/kg in the top 6 inches of soil. EPA was able to obtain access agreements to only 13 of the 15 properties. The properties were remediated between June 9 and September 22, 2008, by Weston Solutions, Inc. (Weston) and Environmental Quality Management (EQM) under a Time Critical Removal Action (TCRA). The properties were excavated to a depth of 1 to 2.5 feet bgs. Weston used an XRF instrument to field screen and confirm that excavation was completed to a depth where lead concentrations were below 400 mg/kg. All the properties were backfilled with clean fill and re-sodded by September 25, 2008. A total of 1,838 tons of soil was transported offsite to a landfill facility as special waste (SulTRAC 2012).

The USS Lead Superfund Site (comprising both OU1 and OU2) was evaluated under the Hazard Ranking System (HRS) in September 2008 and was found to have an observed release of lead in the air migration pathway as well as the surface water migration pathway (EPA 2008). The USS Lead Site was listed as a Superfund site on the National Priorities List (NPL) on April 8, 2009.

B2.2 PREVIOUS SITE INVESTIGATIONS AND REMOVAL ACTIONS

Many investigations have been conducted as part of the USS Lead Superfund Site (OU1 and OU2). The following is a list of the investigations that have been conducted from 1985 to the present. These investigations are discussed in the Remedial Investigation (RI) report (SulTRAC 2012).

- 1985 Inspection Report of Hammond Lead and USS Lead Refining Soil Survey (OU2)
- 2001 Site-Wide Sampling and Analysis Report (OU2)

- 2001 USS Lead MRFI Addendum Off-Site Sampling and Analysis Report (OU2)
- 2002 Air Dispersion Modeling and Historical Aerial Photography Review (OU1 and OU2)
- 2003 Report on X-Ray Fluorescence Field Study of Selected Properties in Vicinity of Former USS Lead-Refinery Facility, East Chicago, Indiana (OU1)
- 2004 Off-Site Soil Excavation, Howard Industries (OU2 HI Triangle Area)
- 2004 Off-Site Soil Excavation, Indiana Harbor Belt Railroad (OU2 IHBRR Triangle Area)
- 2004 Off-Site Soil Excavation Kennedy Avenue (OU2 Eastern Off-Site Area)
- 2004 On-Site Soil Excavation (OU2 Wetlands Area)
- 2004 Draft Final USS Lead, Modified RCRA Facility Investigation (MRFI) Report (OU2)
- 2004 Draft Characterization of Lead and Other Metals in Soil in the Vicinity of the USS Lead Site, East Chicago, Indiana (OU1 and OU2)
- 2006 EPA FIELDS Investigation (OU1)
- 2007 STN Draft Site Assessment Letter Report, USS Lead Site (Background Study)
- 2008 Hazard Ranking Summary Documentation Record (OU1 and OU2)

2008 CERCLA Time Critical Removal Action:

On June 9, 2008, U.S. EPA; the Weston Solutions, Inc. (WESTON®), Superfund Technical Assessment and Response Team (START); and Environmental Quality Management (EQM), the Emergency and Rapid Response Services (ERRS) contractor, mobilized to the Site to begin the removal of lead-contaminated soil from 13 residential properties. The residential removal cleanup level was established at 400 ppm.

Removal activities were completed on September 25, 2008. The ERRS contractor arranged for the transportation and disposal of 1,838 tons of lead-contaminated soil at the Forest Lawn Landfill. Clean backfill for the Removal Action totaled 3,120 cubic yards (U.S. EPA 2009).

2011 Time Critical Removal Action:

EPA completed a TCRA of 16 properties with lead in soil concentrations exceeding 400 mg/kg from October through December 2011. The TCRA consisted of removing lead-contaminated soil from 5 East Chicago public housing addresses and 11 residential properties (2 of which were not remediated in the prior 2008 TCRA due to access issues). The TCRA was conducted between October 24 and December 9, 2011. Approximately 1,913 tons of low-level lead-contaminated soil were excavated during the TCRA

and the material was sent to an off-site location for disposal. Each property was backfilled to the existing grade and seeded after the soil removal was completed.

2009 Remedial Investigation/Feasibility Study:

In 2009, U.S. EPA Superfund began a Remedial Investigation and Feasibility study. In 2010, the City of East Chicago remediated yards at 2 properties that were above the U.S. EPA RSL for lead (400 ppm). The Remedial Investigation and Feasibility Study were completed in 2012 (SulTRAC 2012a; SulTRAC 2012b).

B3.0 QUALITY ASSURANCE PROJECT PLAN PROCEDURES

This QAPP presents procedures that will be used to ensure the quality of data generated for the USS Lead Superfund Site. The QAPP provides a framework for how environmental data will be collected to achieve specific project objectives; it also describes procedures that will be implemented to obtain data of known and adequate quality. This QAPP was prepared in accordance with the EPA's "Uniform Federal Policy for Implementing Environmental Quality Systems" (UFP) (EPA 2005).

The primary purpose of this QAPP is to describe the approach that will be used to conduct the Remedial Design sampling at the USS Lead Site. The objective of the Remedial Design sampling is to determine the lateral and vertical extent of lead-contaminated and arsenic-contaminated soils at residences, schools, parks, vacant lots, and other areas where residents or onsite workers may come into contact with contaminated soil.

The Remedial Design sampling will be conducted in multiple phases based on which zone is being sampled (Figure B-2). Zone 1 will be sampled first followed by Zone 3. SulTRAC anticipates that Zone 1 will be sampled in one continuous event. Zone three will likely be sampled in two sampling events based on availability of access agreements from property owners. Zone 2 sampling will happen last and will also be sampled in two to three sampling events based on property access. SulTRAC intends to conduct Remedial Design sampling in an uninterrupted process to the extent possible. However, it is anticipated that some properties will lag behind due to difficulties obtaining access agreements and SulTRAC will be required to go back to a particular zone to complete sampling.

QAPP WORKSHEET #1
TITLE AND APPROVAL PAGE

Quality Assurance Project Plan for Remedial Design, USS Lead Site, East Chicago, Lake County, Indiana

Document Title

SulTRAC

Lead Organization

Robert Thompson, SulTRAC

Preparer's Name and Organizational Affiliation

125 South Wacker Drive, Suite 220, Chicago IL 60606; (312) 443-0550; rthompson@onesullivan.com

Preparer's Address, Telephone Number, and E-mail Address

September 23, 2014

Preparation Date

Richard Baldino

SulTRAC Project Manager

To be Signed at Final

Signature/Date

John Dirgo

SulTRAC QA Officer

To be Signed at Final

Signature/Date

Approval Signatures:

Approval Authority

Other Approval Signatures:

Signature/Date

Michael Berkoff, Work Assignment Manager

QAPP WORKSHEET #2
QAPP IDENTIFYING INFORMATION

-
1. Identify guidance used to prepare QAPP:
"Uniform Federal Policy for Implementing Environmental Quality Systems" (UFP) (EPA 2005) and
"EPA Guidance for Quality Assurance Project Plans" (EPA 2002)

 2. Identify regulatory program:
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

 3. Identify approval entity: EPA Region 5

 4. Indicate whether the QAPP is a generic or project-specific QAPP: Project-specific

 5. List dates of scoping sessions that were held: June 24, 2014

 6. List dates and titles of QAPP documents written for previous work at site, if applicable:

<u>Title</u>	<u>Approval Date</u>
Remedial Investigation Report	June 2012
US Smelter and Lead Refinery (USS Lead)	
Lake County, Indiana	

 7. List organizational partners (stakeholders) and connection with lead organization:
EPA Region 5, SulTRAC, Indiana Department of Environmental Management (IDEM)

 8. List data users: EPA Region 5, SulTRAC, IDEM

 9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below: No specific audits or assessments have been planned for this project, so Worksheet Nos. 31 and 32 are not applicable.
-

QAPP WORKSHEET #2 (CONTINUED)
QAPP IDENTIFYING INFORMATION

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Documents
Project Management and Objectives		
2.1 - Title and Approval Page	Title and Approval Page	1
2.2 - Document Format and Table of Contents	Table of Contents	
2.2.1 Document Control Format	QAPP Identifying Information	2
2.2.2 Document Control Numbering System		
2.2.3 Table of Contents		
2.2.4 QAPP Identifying Information		
2.3 - Distribution List and Project Personnel Sign-Off Sheet		
2.3.1 Distribution List	Distribution List	3
2.3.2 Project Personnel Sign-Off Sheet	Project Personnel Sign-Off Sheet	4
2.4 - Project Organization		
2.4.1 Project Organization Chart	Project Organization Chart	5
2.4.2 Communication Pathways	Communication Pathways	6
2.4.3 Personnel Responsibilities and Qualifications	Personnel Responsibilities and Qualifications	7
2.4.4 Special Training Requirements and Certification	Special Training Requirements and Certification	8
2.5 - Project Planning/Problem Definition		
2.5.1 Project Planning (Scoping)	Project Planning Session Documentation (including Data Needs tables)	9
	Project Scoping Session Participants Sheet	
2.5.2 Problem Definition, Site History, and Background	Problem Definition, Site History, and Background	10
	Site Maps (historical and present)	Figure B1

QAPP WORKSHEET #2 (CONTINUED)
QAPP IDENTIFYING INFORMATION

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Documents
2.6 - Project Quality Objectives (PQO) and Measurement Performance Criteria		
2.6.1 Development of PQOs Using the Systematic Planning Process	Site-Specific PQOs	11
2.6.2 Measurement Performance Criteria	Measurement Performance Criteria Table	12
2.7 - Secondary Data Evaluation	Sources of Secondary Data and Information	13
	Secondary Data Criteria and Limitations Table	
2.8 - Project Overview and Schedule		
2.8.1 Project Overview	Summary of Project Tasks	14
	Reference Limits and Evaluation Table	15
2.8.2 Project Schedule	Project Schedule/Timeline Table	16
Measurement/Data Acquisition		
3.1 - Sampling Tasks		
3.1.1 Sampling Process Design and Rationale	Sampling Design and Rationale	17, Field Sampling Plan
	Sampling Location Map	18, Figure B1
	Sampling Locations and Methods/Standard Operating Procedures (SOP) Requirements Table	
3.1.2 Sampling Procedures and Requirements		
3.1.2.1 Sampling Collection Procedures	Field Quality Control Sample Summary Table	20
	Sampling SOPs	21
	Project Sampling SOP References Table	21
3.1.2.2 Sample Containers, Volume, and Preservation	Analytical Methods/SOP Requirements Table	19, 23

QAPP WORKSHEET #2 (CONTINUED)
QAPP IDENTIFYING INFORMATION

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Documents
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures	Analytical Methods, Containers, Preservatives, and Holding Times Table	19
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	Field Equipment, Calibration, Maintenance, Testing, and Inspection Procedures Table	22
3.1.2.5 Supply Inspection and Acceptance Procedures		
3.1.2.6 Field Documentation Procedures		
3.2 - Analytical Tasks		
3.2.1 Analytical SOPs	Analytical SOPs	23
	Analytical SOP References Table	
3.2.2 Analytical Instrument Calibration Procedures	Analytical Instrument Calibration Table	24
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	25
3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 - Sample Collection Documentation, Handling, Tracking, and Custody Procedures	Sample Collection Documentation Handling, Tracking, and Custody SOPs	26, Field Sampling Plan
3.3.1 Sample Collection Documentation	Sample Container Identification	26, 27, Field Sampling Plan
3.3.2 Sample Handling and Tracking System	Sample Handling Flow Diagram	
3.3.3 Sample Custody	Example Chain-of-Custody Form and Seal	
3.4 - Quality Control (QC) Samples		
3.4.1 Sampling QC Samples	QC Samples Table	28
3.4.2 Analytical QC Samples		
3.5 - Data Management Tasks		
3.5.1 Project Documentation and Records	Project Documents and Records Table	29

QAPP WORKSHEET #2 (CONTINUED)
QAPP IDENTIFYING INFORMATION

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Documents
3.5.2 Data Package Deliverables	Analytical Services Table	30
3.5.3 Data Reporting Formats	Data Management SOPs	23 (specified by analytical method) Data Management Plan
3.5.4 Data Handling and Management		
3.5.5 Data Tracking and Control		
Assessment/Oversight		
4.1 - Assessments and Response Actions		
4.1.1 Planned Assessments	Planned Project Assessments Table	31
	Audit Checklists	
4.1.2 Assessment Findings and Corrective Action (CA) Responses	Assessment Findings and CA Responses Table	32
4.2 - QA Management Reports	QA Management Reports Table	33
4.3 - Final Project Report	RI/FS	Not applicable (NA)
Data Review		
5.1 - Overview	NA	NA
5.2 - Data Review Steps		
5.2.1 Step I: Verification	Verification (Step I) Process Table	34
5.2.2 Step II: Validation		
5.2.2.1 Step IIa Validation Activities	Validation (Steps IIa and IIb) Process Table	35
5.2.2.2 Step IIb Validation Activities	Validation (Steps IIa and IIb) Summary Table	36

QAPP WORKSHEET #2 (CONTINUED)
QAPP IDENTIFYING INFORMATION

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Documents
5.2.3 Step III: Usability Assessment		
5.2.3.1 Data Limitations and Actions from Usability Assessment	Usability Assessment	37
5.2.3.2 Activities		
5.3 - Streamlining Data Review	NA	NA
5.3.1 Data Review Steps to be Streamlined		
5.3.2 Criteria for Streamlining Data Review		
5.3.3 Amounts and Types of Data Appropriate for Streamlining		

**QAPP WORKSHEET #3
DISTRIBUTION LIST**

(UFP QAPP Section 2.3.1)

List individuals who received copies of the approved QAPP, subsequent QAPP revisions, addenda, and amendments.

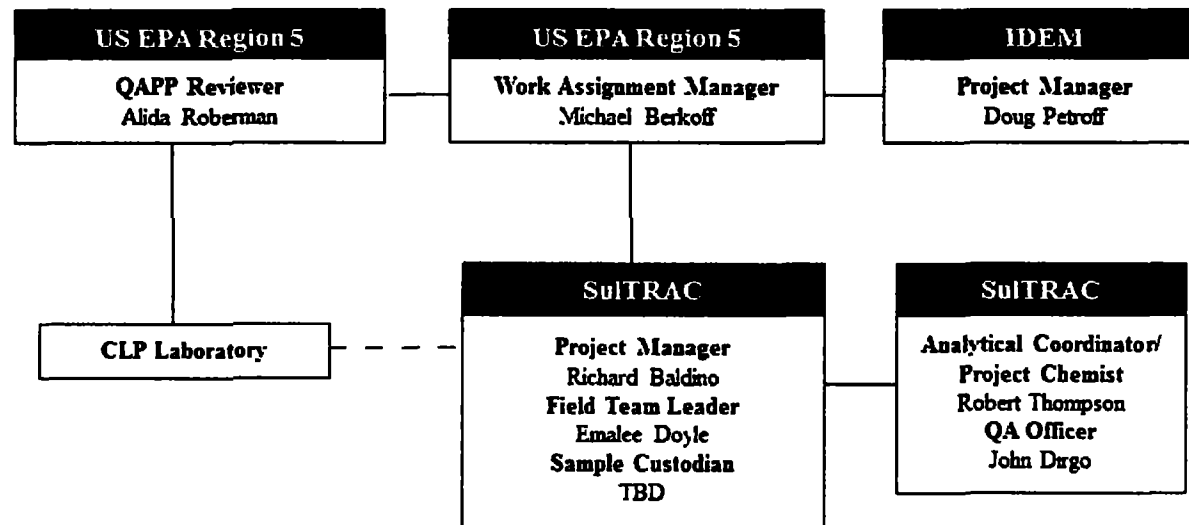
QAPP Recipient	Title	Organization	Telephone Number	E-mail Address
Michael Berkoff	Work Assignment Manager (WAM)	EPA Region 5	(312) 353-8983	Berkoff.michael@epa.gov
Alida Roberman	QAPP Reviewer	EPA Region 5	(312)886-7185	alida.roberman.epa.gov
Richard Baldino	Project Manager	SulTRAC	(312) 443-0550, ext. 26	rbaldino@onesullivan.com
Emalee Doyle	Field Team Leader/Site Superintendent	SulTRAC	(312) 443-0550	edoyle@onesullivan.com
John Dirgo	QA Officer	SulTRAC	(312) 201-7765	john.dirgo@ttemi.com
Robert Thompson	Analytical Coordinator/Project Chemist	SulTRAC	(312) 443-0550, ext. 35	rthompson@onesullivan.com
David Homer	Ecological Risk Assessor	SulTRAC	(816) 412-1762	david.homer@ttemi.com
Eric Morton	Human Health Risk Assessor	SulTRAC	(312) 201-7797	eric.morton@ttemi.com

QAPP WORKSHEET #4
PROJECT PERSONNEL SIGN-OFF SHEET

(UFP QAPP Section 2.3.2)

Project Personnel	Organization	Title	Telephone No.	Signature	Date QAPP Read
Richard Baldino	SuITRAC	Project Manager	(312) 443-0550, ext. 26		
Robert Thompson	SuITRAC	Analytical Coordinator/Project Chemist	(312) 443-0550, ext. 35		
John Dirgo	SuITRAC	QA/QC Officer	(312) 201-7765		
Emalee Doyle	SuITRAC	Field Team Leader	(312)443-0550		
TBD	SuITRAC	Sample Custodian	TBD		

QAPP WORKSHEET #5 PROJECT ORGANIZATION CHART



Notes
CLP: Contract laboratory program
EPA: Environmental Protection Agency
IDEM: Indiana Department of Environmental Management
QA: Quality assurance
QAPP: Quality assurance project plan



QAPP WORKSHEET #6 COMMUNICATION PATHWAYS

(UFP QAPP Section 2.4.2)

Communication Drivers	Responsible Entity	Name	Telephone No.	Procedure (Timing, Pathways, etc.)
Point of contact with EPA WAM	Project Manager	Richard Baldino	(312) 443-0550, ext. 26	Richard Baldino will forward all materials and information about the project to Michael Berkoff.
Manage all project phases	Project Manager	Richard Baldino	(312) 443-0550, ext. 26	Communicate information to project team on a timely basis. Notify EPA WAM by telephone or e-mail of any significant issues. Direct field team and facilitate communication with analytical coordinator. Delivery of all CLP data packages to project QA manager for final review of validation.
Daily field progress report	Field Team Leader	Emalee Doyle	(312)443-0550	Conduct specific field investigation tasks, direct field activities of subcontractors, and provide daily communication with project manager and sample custodian.
Manage field sample organization and delivery to Contract Laboratory Program (CLP)	Sample Custodian	TBD	TBD	Ensure field staff is collecting samples in proper containers, observing holding times, and properly packaging and preparing samples for shipment. Coordinate daily with analytical coordinator concerning sample quantities and delivery locations and dates. Communicate daily with field staff and project manager regarding any issues and developments.
Point of contact with EPA Region 5 Regional Sample Control Coordinator (RSCC)	Analytical Coordinator	Robert Thompson	(312) 443-0550, ext. 35	Contact the RSCC before each sampling event to schedule CLP laboratory services. Notify sample custodian and project manager of any CLP issues or developments. Track all CLP data deliveries. Notify project manager and forward data to him.

QAPP WORKSHEET #6 (CONTINUED)
COMMUNICATION PATHWAYS

Communication Drivers	Responsible Entity	Name	Telephone No.	Procedure (Timing, Pathways, etc.)
Release of Analytical Data	SulTRAC Project Chemist	Robert Thompson	(312)443-0550x35	No analytical data can be released until validation is completed and project QA manager has reviewed and approved the release.
Report of laboratory data quality issues	Laboratory QA Officer	CLP Laboratory Manager	TBD	All QA/QC issues with project field samples will be reported by the laboratory QA officer to the RSCC.

QAPP WORKSHEET #7
PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE

(UFP QAPP Section 2.4.3)

Name	Title	Organization/ Affiliation	Responsibilities	Education and Experience Qualifications
Richard Baldino	Project Manager	SulTRAC	Manages project; coordinates between lead agency and project team; coordinates CLP data deliverables from analytical coordinator to project QA manager; manages field staff	M.S. Chemistry, 21 years of experience.
Emalee Doyle	Field Team Leader	SulTRAC	Supervises field sampling and coordinates all field activities; daily reporting to project manager while conducting field activities	M.S. Earth Science, B.S. Geology, P.G., Senior Geologist, 15+ years of experience
TBD	Sample Custodian	SulTRAC	Implements field plan; verifies sample processing, packaging, and shipping	TBD.
Robert Thompson	Analytical Coordinator/ Project Chemist	SulTRAC	Prepares QAPP, reviews data for completeness and to ensure data meets project quality requirements. Coordinates sample scheduling; verifies sample chain of custody; reviews computer-aided data review (CADRE) results; notifies sample custodian and project manager of any issues or developments	B.A.Chemistry, Project Chemist, 10 years of experience
John Dirgo	QA Officer	SulTRAC	Reviews QAPP; QA/QC oversight	Sc.D. Environmental Science and Physiology, 30+ years of experience

QAPP WORKSHEET #8 SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

(UFP QAPP Section 2.4.4)

No special training is required; however, a description of the routine training and certification requirements for implementation of the proposed work is presented below.

Routine Training and Certification Requirements

This section outlines the training and certifications required for SulTRAC and subcontractor personnel to complete the activities described in this QAPP.

Field Work Training

Field team members will be adequately trained in field methods and sampling procedures outlined in this UFP-QAPP and in following SulTRAC Standard Operating Procedures (SOPs; see Attachment A). Specifically, field team members will have training in the following field activities:

- Sample handling, packaging, and shipping
- Use of related field equipment (e.g. XRF)
- Handling of investigation-derived waste (IDW)
- Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response certification, in addition to annual 8-hour refresher
- First Aid and cardiopulmonary resuscitation (CPR) certification (Field Team Leader at a minimum)

Training will be provided by the Site Superintendent, who is required to have a minimum of three years of direct field experience with air sampling, sample handling, sample packaging and shipping, field equipment operation, and handling of hazardous and non-hazardous wastes.

QAPP WORKSHEET #8 (CONTINUED)

SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

Health and Safety Training

SulTRAC and subcontractor personnel who work at hazardous-waste project sites are required to meet the OSHA training requirements defined in Title 29 of the *Code of Federal Regulations* (CFR), Section 1910.120(e). These requirements are as follows: (1) 40 hours of formal off-site instruction; (2) a minimum of three days of actual on-site field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training.

Field personnel who directly supervise employees engaged in hazardous waste operations must also receive at least 8 additional hours of annual specialized supervisor training that covers health and safety program requirements, training requirements, personal protective equipment (PPE) requirements, spill containment program requirements, and health-hazard monitoring procedures and techniques. At least one member of every field team will maintain current certification in the American Red Cross "Multimedia First Aid" and "CPR Modular" or equivalent.

Copies of SulTRAC personnel health and safety training records, including course completion certifications for the initial and refresher health and safety training, specialized supervisor training, and First Aid and CPR training, are maintained in the project files and will be provided in the project-specific Health and Safety Plan (HASP), which will be present on-site while work is being performed.

Before work begins at a specific hazardous-waste project site, SulTRAC personnel are required to undergo site-specific training in the following:

- Names of personnel and alternates responsible for health and safety at the hazardous waste project site
- Health and safety hazards present at the project site
- Selection of the appropriate levels of PPE
- Correct use of PPE
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment at the project site

Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazardous

**QAPP WORKSHEET #9
PROJECT SCOPING SESSION PARTICIPANTS SHEET**

(UFP QAPP Section 2.5.1)

Project Name	USS Lead Remedial Design OU1		Site Name	USS Lead Site	
Projected Date(s) of Sampling	Fall 2014-Fall 2015		Site Location	East Chicago, Indiana 46312	
Project Manager	Richard Baldino				
Date of Session	June 24, 2014				
Scoping Session Purpose:	Define scope of project, discuss remedial design sampling strategy which included zoning, TCLP and waste characterization, PRP desires, access agreements, and costs.				
Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Michael Berkoff	WAM	EPA Region 5	(312) 353-8983	Berkoff.michael@epa.gov	WAM
Richard Baldino	Project Manager	SulTRAC	(312) 443-0550 ext 26	rbaldino@onesullivan.com	Project Manager
J. D. Campbell	Program Manager	SulTRAC	(312)443-0550 ext.23	jdccampbell@onesullivan.com	Program Manager
Donna Plumb	Contracting Specialist	EPA Region 5	(312)353-1612	plumb.donna@epa.gov	Contracting Specialist
Daniel Olsson	Contracting Officer	EPA Region 5	(312)886-1423	olsson.daniel@epa.gov	Contracting Officer
Mindy Gould	Technical Expert	SulTRAC	(312)201-7460	mindy.gould@tetrattech.com	Technical Expert

QAPP WORKSHEET #10 PROBLEM DEFINITION

(UFP QAPP Section 2.5.2)

The problem to be addressed by the project: The purpose of this investigation is to conduct a remedial design investigation for OU1.

The environmental questions being asked: What is the extent of lead and arsenic contamination at locations within OU1? Do lead and or arsenic concentrations in residential soils (including schools and parks) exceed the two action levels of 400 mg/kg and 26 mg/kg respectively? Do lead and or arsenic concentrations in industrial soils exceed the two action levels of 800 mg/kg and 26 mg/kg respectively?

Observations from any site reconnaissance reports: In 2003 and 2006, EPA sampled soils in the residential area north of USS Lead for lead contamination. In 2008, 13 private residential yards were removed by the Superfund Removal Program due to lead concentrations above time-critical removal action levels (1,200 mg/kg). In 2011, 16 private residential yards were removed by the Superfund Removal Program due to lead concentrations above time-critical removal action levels (400 mg/kg). In addition SulTRAC sampled approximately 105 properties between 2009-2010.

A synopsis of secondary data or information from site reports: See Worksheet #13

The possible classes of contaminants and the affected matrices: Soil samples will be analyzed for total lead and arsenic by XRF. Select samples that exhibit lead concentrations between 300-400 mg/kg (650 mg/kg to 800 mg/kg for industrial/commercial properties) and/or arsenic concentrations between 20-30 mg/kg will be sent to a CLP laboratory for confirmation analysis. In addition, soil samples exhibiting XRF concentrations for lead above 400 mg/kg in residential soils (including parks and schools) or 800 mg/kg in commercial /industrial, and/or arsenic concentrations above 26 mg/kg will be sent to a CLP laboratory for TCLP analysis.

Project decision conditions ("If..., then..." statements): If lead contamination in residential soils exceeds 400 mg/kg, then excavation will be warranted at the designated depth. If lead contamination in industrial/commercial soils exceeds 800 mg/kg, then excavation will be warranted at the designated depth. If arsenic contamination exceeds 26 mg/kg, then exaction will be warranted at the designated depths.

QAPP WORKSHEET #11
PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP QAPP Section 2.6.1)

Who will use the data: EPA Region 5 and SulTRAC will use the data.
What will the data be used for? Data collected during this remedial design investigation will be used to support decisions (e.g. depths of excavation need) for remedial action.
What type of data are needed (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)? Surface and subsurface soils will be collected from 1,150 properties including residences, vacant lots, parks, and schoolyards at the USS Lead site. For residential properties and vacant lots, composite samples will be collected from the front and back yards at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches below ground surface (bgs). The last interval of 24-30 inches bgs will only be collected if native sand is not encountered. Five-point depth-discrete composite samples will be collected from each of five different depths in each yard, in the configuration of an "X," with samples from each corner and one in the center. Each depth-discrete composite sample will consist of the 5 samples collected in the X-configuration from a single depth interval (0-6, 6-12, 12-18, 18-24, 24-30 inches bgs). Parks, schools, industrial/commercial properties, and right-of-ways will be divided into four quadrants, and a five-point composite sample will be collected at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs. In addition, grab samples will be collected from each play area in each park at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs. XRF analysis for total lead and arsenic will be performed using an Innov-X XRF analyzer on all soil samples collected. If a composite soil sample at a particular interval is exhibiting lead concentrations of 300-400 mg/kg in residential soils (including parks and schools) or 650-800 mg/kg in industrial/commercial soils and/or arsenic concentrations of 20-30 mg/kg, then the composite sample will be sent to a CLP laboratory for confirmation analysis. Additionally, if lead concentrations are above 400 mg/kg in residential soils (including parks and schools) or 800 in industrial/commercial soils and/or if arsenic concentrations are above 26 mg/kg, then the samples will be submitted to the CLP laboratory for TCLP analysis.
How "good" do the data need to be in order to support the environmental decision? Ultimately, the data need to allow full assessment of the nature and extent of contamination in the soil samples collected by SulTRAC. The data will be validated and used for decision making by EPA for remedial action activities. The accuracy of XRF results will be established by using regression analysis to derive a correlation between XRF and CLP results. The correlation will be used to derive a correction factor, which will be applied to all XRF data. Where both CLP and XRF lead concentrations are available, the CLP results will be used for regulatory decisions about remedial actions. Where only XRF results are available, the corrected XRF results will be used.

Roberman, Alida

From: Berkoff, Michael
Sent: Wednesday, October 15, 2014 9 52 AM
To: Roberman, Alida
Subject: FW: USS Lead QAPP Revised Pages
Attachments: removed txt, Draft USS Lead QAPP S198.revised pages 141008 pdf

Alida,
Here are the pages. Thank you for looking at these quickly.
Michael

From: Baldino, Richard [mailto:RBaldino@onesullivan.com]
Sent: Wednesday, October 08, 2014 2:44 PM
To: Alida Roberman
Cc: Berkoff, Michael
Subject: USS Lead QAPP Revised Pages

Alida:
Thank you very much for taken a few minutes to speak with me yesterday regarding the USS Lead QAPP. Please find attached the pages that have been revised from the original draft submittal. I have highlighted the changes in yellow in the attached file.

As we discussed, there are three general changes that were made which are reflected on the attached QAPP Worksheets:

- 1) We changed the level of effort on data validation from 100% to ^{50%}20% for total metals. No TCLP data validation is required. I have assumed that 100% of the data will go through CADRE review, but that is an easy change if we need to make it.
- 2) We added TCLP analysis for VOCs and SVOCs (along with corrosivity and ignitability) for soils stained with TPH.
- 3) We also have revised trigger limits for when we do TCLP analysis for lead and arsenic.

Please let me know if you have any questions or concerns. Also, let me know if you would prefer to have one large document with the changes highlighted instead of "insertion pages".

Thanks, and I will talk to you again soon.



Richard Baldino, M.S.
Project Manager/Chemistry Practice Lead
Sullivan International Group, Inc
125 S Wacker Dr . Suite 220
Chicago, IL 60606
(312) 443-0550 x26
(312) 882-1285 cell
(312) 443-0557 fax
rbaldino@onesullivan.com
www.onesullivan.com
Certified SDB, DVBE, SDVOB
Safety First...Safety Lasts!

Confidentiality Notice: Please note - this e-mail and any attached documents or messages may contain confidential and legally privileged information. If you are not the intended recipient, have otherwise received this e-mail in error or are not the person responsible for ensuring this message's delivery to the intended recipient, then you are: 1) notified that any disclosure, copying, distribution, saving, reading or use of this information is strictly prohibited, 2) requested to discard and delete this e-mail and any attachments, and 3) requested to immediately notify the sender by e-mail that you mistakenly received this message. Thank You - Sullivan International Group, Inc.

Confidentiality Notice Please note - this e-mail and any attached documents or messages may contain confidential and legally privileged information. If you are not the intended recipient, have otherwise received this e-mail in error or are not the person responsible for ensuring this message's delivery to the intended recipient then you are: 1) notified that any disclosure, copying, distribution, saving, reading or use of this information is strictly prohibited, 2) requested to discard and delete this e-mail and any attachments and 3) requested to immediately notify the sender by e-mail that you mistakenly received this message. Thank You - Sullivan International Group, Inc.

QAPP WORKSHEET #10 PROBLEM DEFINITION

(UFP QAPP Section 2.5.2)

<p>The problem to be addressed by the project: The purpose of this investigation is to conduct a remedial design investigation for OUI.</p>
<p>The environmental questions being asked: What is the extent of lead and arsenic contamination at locations within OUI? Do lead and or arsenic concentrations in residential soils (including schools and parks) exceed the two action levels of 400 mg/kg and 26 mg/kg respectively? Do lead and or arsenic concentrations in industrial soils exceed the two action levels of 800 mg/kg and 26 mg/kg respectively?</p>
<p>Observations from any site reconnaissance reports: In 2003 and 2006, EPA sampled soils in the residential area north of USS Lead for lead contamination. In 2008, 13 private residential yards were removed by the Superfund Removal Program due to lead concentrations above time-critical removal action levels (1,200 mg/kg). In 2011, 16 private residential yards were removed by the Superfund Removal Program due to lead concentrations above time-critical removal action levels (400 mg/kg). In addition SulTRAC sampled approximately 105 properties between 2009-2010.</p>
<p>A synopsis of secondary data or information from site reports: See Worksheet #13</p>
<p>The possible classes of contaminants and the affected matrices: Soil samples will be analyzed for total lead and arsenic by XRF. Select samples that exhibit lead concentrations between 300-400 mg/kg (650 mg/kg to 800 mg/kg for industrial/commercial properties) and/or arsenic concentrations between 20-30 mg/kg will be sent to a CLP laboratory for confirmation analysis. In addition, soil samples exhibiting XRF concentrations for lead above 2000 mg/kg and/or arsenic concentrations above 100 mg/kg will be sent to a CLP laboratory for TCLP analysis of arsenic and/or lead. If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory for TCLP VOCs, TCLP SVOCs, Ignitibility, and Corrosivity.</p>
<p>Project decision conditions ("If..., then..." statements): If lead contamination in residential soils exceeds 400 mg/kg, then excavation will be warranted at the designated depth. If lead contamination in industrial/commercial soils exceeds 800 mg/kg, then excavation will be warranted at the designated depth. If arsenic contamination exceeds 26 mg/kg, then excavation will be warranted at the designated depths.</p>

QAPP WORKSHEET #11
PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP QAPP Section 2.6.1)

Who will use the data: EPA Region 5 and SulTRAC will use the data.

What will the data be used for? Data collected during this remedial design investigation will be used to support decisions (e.g. depths of excavation need) for remedial action.

What type of data are needed (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)? Surface and subsurface soils will be collected from 1,150 properties including residences, vacant lots, parks, and schoolyards at the USS Lead site. For residential properties and vacant lots, composite samples will be collected from the front and back yards at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches below ground surface (bgs). The last interval of 24-30 inches bgs will only be collected if native sand is not encountered. Five-point depth-discrete composite samples will be collected from each of five different depths in each yard, in the configuration of an "X," with samples from each corner and one in the center. Each depth-discrete composite sample will consist of the 5 samples collected in the X-configuration from a single depth interval (0-6, 6-12, 12-18, 18-24, 24-30 inches bgs). Parks, schools, industrial/commercial properties, and right-of-ways will be divided into four quadrants, and a five-point composite sample will be collected at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs. In addition, grab samples will be collected from each play area in each park at depth intervals of 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs.

XRF analysis for total lead and arsenic will be performed using an Innov-X XRF analyzer on all soil samples collected. If a composite soil sample at a particular interval is exhibiting lead concentrations of 300-400 mg/kg in residential soils (including parks and schools) or 650-800 mg/kg in industrial/commercial soils and/or arsenic concentrations of 20-30 mg/kg, then the composite sample will be sent to a CLP laboratory for confirmation analysis. Additionally, if lead concentrations are above 2000 mg/kg and/or if arsenic concentrations are above 100 mg/kg, then the samples will be submitted to the CLP laboratory for TCLP analysis of lead and/or arsenic. If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory for TCLP VOCs, TCLP SVOCs, Ignitability, and Corrosivity.

How "good" do the data need to be in order to support the environmental decision? Ultimately, the data need to allow full assessment of the nature and extent of contamination in the soil samples collected by SulTRAC. The data will be validated and used for decision making by EPA for remedial action activities. The accuracy of XRF results will be established by using regression analysis to derive a correlation between XRF and CLP results. The correlation will be used to derive a correction factor, which will be applied to all XRF data. Where both CLP and XRF lead concentrations are available, the CLP results will be used for regulatory decisions about remedial actions. Where only XRF results are available, the corrected XRF results will be used.

QAPP WORKSHEET #12 (CONTINUED)
MEASUREMENT PERFORMANCE CRITERIA TABLE

Matrix	Soil/Solids				
Analytical Group	TCLP VOCs/CLP				
Concentration Level	Multi-concentration				
Sampling Procedure¹	Analytical Method SOP²	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
S-1, S-2	A-4	Precision	RPD \leq 50%	Field duplicate	S & A
S-1, S-2	A-4	Accuracy/Bias Contamination	VOC < QL	Trip blank	S & A
S-1, S-2	A-4	Accuracy/Bias Contamination	VOC < QL	Rinsate blank	S & A
S-1, S-2	A-4	Accuracy/Bias	Benzene: 76-127 %R Toluene: 76-125 %R	MS/MSD	A
S-1, S-2	A-4	Precision	Benzene: 11% RPD Toluene: 13% RPD	MS/MSD	A
S-1, S-2	A-4	Accuracy	2-Butanone-d ₃ : 49-155 %R Benzene-d ₆ : 77-124 %R Toluene-d ₈ : 77-121 %R 2-Hexanone-d ₂ : 28-135 %R	Deuterated monitoring compounds	A
S-1, S-2	A-4	Sensitivity/Contamination	VOC < QL	Method blank	A
S-1, S-2	A-4	Completeness	>90%	Data Completeness defined as data not qualified as rejected after validation	S&A

Notes:

The measurement performance criteria listed above is for total lead and arsenic by CLP SOW ISM01.3. TCLP method will follow the same criteria.

DQI Data quality indicator

QL Quantitation limit

%R Percent recovery

RPD Relative percent difference

¹ Reference number from QAPP Worksheet #21

² Reference number from QAPP Worksheet #23

**QAPP WORKSHEET #12 (CONTINUED)
MEASUREMENT PERFORMANCE CRITERIA TABLE**

Matrix	Soil/Solids				
Analytical Group	TCLP SVOCs/CLP				
Concentration Level	Multi-concentration				
Sampling Procedure ¹	Analytical Method SOP ²	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
S-1, S-2	A-5	Precision	RPD \leq 50%	Field duplicate	S & A
S-1, S-2	A-5	Accuracy/Bias: Contamination	SVOC < QL	Rinsate blank	S & A
S-1, S-2	A-5	Accuracy/Bias	Phenol: 12-110 %R N-Nitrosodi-n-propylamine: 41-116%R Acenaphthene: 46-118 %R 4-Nitrophenol: 10-80 %R 2,4-Dinitrotoluene: 24-96 %R Pyrene: 26-127 %R	MS/MSD	A
S-1, S-2	A-5	Precision	Phenol: 42% RPD N-Nitrosodi-n-propylamine: 38% RPD Acenaphthene: 31% RPD 4-Nitrophenol: 50% RPD 2,4-Dinitrotoluene: 38% RPD Pyrene: 31% RPD	MS/MSD	A
S-1, S-2	A-5	Accuracy	Phenol-d ₅ : 39-106 %R Bis(2-chloroethyl)ether-d ₈ : 40-105 %R 4-Methylphenol-d ₈ : 25-111 %R Nitrobenzene-d ₅ : 43-108 %R 2-Nitrophenol-d ₄ : 40-108 %R Dimethylphthalate-d ₈ : 47-114 %R Acenaphthylene-d ₈ : 41-107 %R 4-Nitrophenol-d ₄ : 33-116 %R Fluorene-d ₁₀ : 42-111 %R 4,6-Dinitro-2-methylphenol-d ₂ : 22-104 %R Anthracene-d ₁₀ : 44-110 %R Pyrene-d ₁₀ : 52-119 %R Benzo(a)pyrene-d ₁₂ : 32-121 %R Fluoranthene-d ₁₀ : 50-150 %R 2-Methylnaphthalene-d ₁₀ : 50-150 %R	Deuterated monitoring compounds	A

**QAPP WORKSHEET #12 (CONTINUED)
MEASUREMENT PERFORMANCE CRITERIA TABLE**

Matrix	Soil/Solids				
Analytical Group	TCLP SVOCs/CLP				
Concentration Level	Multi-concentration				
S-1, S-2	A-5	Sensitivity/Contamination	SVOC < QL	Method blank	A
S-1, S-2	A-5	Completeness	>90%	Data Completeness defined as data not qualified as rejected after validation	S&A

Notes:

The measurement performance criteria listed above is for total lead and arsenic by CLP SOW ISM01.3 TCLP method will follow the same criteria.

DQI Data quality indicator

QL Quantitation limit

%R Percent recovery

RPD Relative percent difference

¹ Reference number from QAPP Worksheet #21

² Reference number from QAPP Worksheet #23

QAPP WORKSHEET #14 SUMMARY OF PROJECT TASKS

(UFP QAPP Section 2.8.1)

Sampling Tasks:

1. Collect 5-point composite soil samples from approximately 1,150 properties (combination of residential, industrial, parks, and schools) from four depth intervals: 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs and analyze them for total lead and arsenic by XRF. The deepest interval of 24-30 inches bgs will only be collected if native sand had not be encountered.
2. If XRF indicates that total lead concentrations for residential soils (including schools and parks) are within the range of 300-400 mg/kg and/or total arsenic concentrations are within 20-30 mg/kg then the soil sample will be sent to a CLP laboratory for confirmation analysis. If XRF indicates that total lead concentrations for industrial/commercial soils are within the range of 650-800 mg/kg and/or total arsenic concentrations are within 20-30 mg/kg then the soil sample will be sent to a CLP laboratory for confirmation analysis. In addition, if total lead concentrations are above 2000 mg/kg and/or if arsenic concentrations are above 100 mg/kg, then the soil sample will be sent to a CLP laboratory for TCLP analysis of lead and/or arsenic. If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory for TCLP VOCs, TCLP SVOCs, Ignitibility, and Corrosivity.
3. Log activities and tasks in field notebook and sampling forms.
4. Prepare sample documentation such as chain-of-custody forms, sample labels, custody seals, etc.

Analysis Tasks: SulTRAC will analyze soil samples by XRF for total lead and arsenic. A CLP laboratory will analyze select field samples for total lead and arsenic in addition to TCLP for lead and/or arsenic, TCLP VOCs, TCLP SVOCs, Ignitibility, and corrosivity.

QC Tasks: The following QC samples will be collected and analyzed during the sampling event: field duplicates and MS/MSD samples.

Secondary Data: See Worksheet #13

Data Management Tasks: Analytical data will be archived in an electronic database after validation.

Documentation and Records: All samples collected will be documented in a logbook using a ballpoint pen. The time of collection, identification number, sampling location, field observations, sampler's name, and analyses will be recorded in the logbook for each sample. Each page of the logbook will be dated, numbered, and signed by SulTRAC personnel. Electronic copies of field data records will be maintained at SulTRAC's Chicago office. SulTRAC will follow custody procedures outlined in SulTRAC's program-level QAPP for the RAC 2 contract. Further specifications are described in the FSP.

Assessment/Audit Tasks: Not applicable.

QAPP WORKSHEET #14 (CONTINUED)
SUMMARY OF PROJECT TASKS

Data Review Tasks: EPA will perform CADRE for all CLP data and will perform data validation on 20% of the CLP analytical data including a case narrative detailing any issues or inconsistencies discovered. SulTRAC will conduct limited data review of all CLP analytical data. The SulTRAC project manager will review the case narrative and will detail any analytical issues that may potentially affect data quality and determine action if needed in consultation with EPA.

QAPP WORKSHEET #17 SAMPLING DESIGN AND RATIONALE

(UFP QAPP Section 3.1.1)

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be collected, and the sampling frequency (including seasonal considerations). (May refer to map or Worksheet #18 for details).

The remedial design sampling will include the collection of XRF soil samples on each property in OU1 that does not already have sufficient data to make remedial design decisions. Eighty-nine properties were sampled during the RI and thirty-one properties have been remediated by START and the City of East Chicago. SulTRAC will collect samples from approximately 1,150 properties within OU1. The field team will attempt to distribute the sample points to provide even coverage of the property/yard sampled. SulTRAC will mobilize to OU1 to conduct an XRF soil investigation for metals. The goal of the screening is to identify residential properties above the cleanup goals for lead and arsenic and provide data adequate to prepare remedial designs.

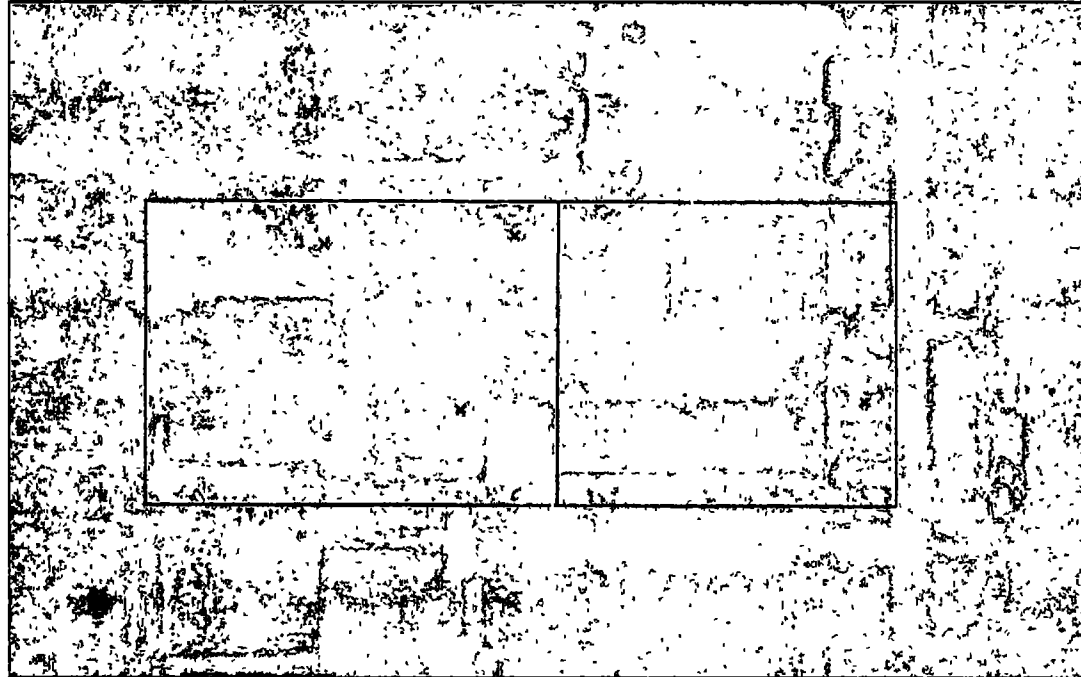
Residential Properties:

Residential properties with a structure on the property will be divided into front and back yards, and a 5 point composite sample will be collected from each front yard and each back yard by depth interval. Drip zones will not be sampled separately. If there are side yards, the 5 point composite may include locations from the side yards. Four depth-discrete 5 point composite samples will be collected from each yard, including 5-point composite samples from 0 6 inches, 6 12 inches, 12 18 inches and 18 24 inches bgs, in an X shaped pattern, with one sample aliquot from each end point of the X and one sample aliquot from the center, as shown in the figure below. The 5 individual aliquots from each point will then be mixed into a depth specific composite sample for analysis by XRF. Typically, eight composite samples will be collected at each residential property (four from the front yard and four from the back yard). If native sand is not encountered in the 18 24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Any composite sample from a yard with XRF readings for lead between 300 ppm and 400 ppm and/or XRF readings for arsenic between 20 ppm and 30 ppm will be submitted to CLP for total lead and/or total arsenic analysis. Any composite sample from a yard with XRF readings for lead above 2000 ppm or arsenic above 100 ppm will be submitted to CLP for TCLP metals analysis. If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory

QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

for TCLP VOCs, TCLP SVOCs, Ignitibility, and Corrosivity!

EXAMPLE COMPOSITE SAMPLE LOCATIONS - RESIDENTIAL PROPERTY



Vacant Lots:

Vacant lots will be divided into two halves to correspond with front and back yards. Four 5 point composites will be collected from each half, and each composite sample will be screened using XRF. If native sand is not encountered in the 18-24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Each yard will be sampled in the same manner as described above for residential properties.

**QAPP WORKSHEET #18
SAMPLING LOCATIONS/IDS, SAMPLE DEPTHS, SAMPLE ANALYSES
AND SAMPLING PROCEDURES TABLE**

(UFP QAPP Section 3.1.1)

Sampling Location ¹ / ID Number	Matrix	Depth (inches bgs)	Analytical Group	Sampling SOP Reference ²
Approximately 1150 locations, composite samples from five depths	Soil ³	0-6 6-12 12-18 18-24 24-30*	Lead by XRF field analysis (1230 samples)	S-1, S-2, S-3
TBD ⁴	Soil ³	TBD ⁴	CLP SOW ISM01.3(Total Lead and Arsenic)	S-1, S-3
TBD ⁵	Soil ³	TBD ⁵	Modified Analysis (MA) CLP SOW ISM01.3 (TCLP Lead and Arsenic)	S-1, S-3
TBD ⁶	Soil ³	TBD ⁵	MA CLP SOW SOM01.2 MA (TCLP VOCs and SVOCs), MA SW-846 1030 MA (Ignitibility), MA SW-846 1110A (Corrosivity)	S-1, S-3

Notes

ID Identification

*The 24-30 inches bgs depth interval will only be collected if native sand has not been encountered in the 18-24 inches bgs interval.

- 1 See Figure B-1 for residential portion of study area
- 2 See Worksheet #21 for a list of sampling methods S-1 through S-3
- 3 Samples will be collected from hand-augered soil borings.
- 4 If XRF data indicates that lead results are between 300-400 mg/kg for residential properties (650-800 mg/kg for industrial/commercial). and/or if arsenic results are between 20-30 mg/kg. then the composite sample will be sent to a CLP laboratory for confirmation analysis.
- 5 If XRF data indicates that lead results are above 2000 mg/kg and/or if arsenic results are above 100 mg/kg, then the composite sample will be sent to a CLP laboratory for TCLP analysis.
- 6 If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory for TCLP VOCs, TCLP SVOCs, Ignitibility, and Corrosivity.

QAPP WORKSHEET #19
ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES TABLE

(UFP QAPP Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)¹
Soil	Lead and Arsenic	CLP SOW ISM01.3	Two 4-ounce wide-mouth glass jars	Cool to 4 ± 2 C	NA/6 months
Soil	TCLP Lead and TCLP Arsenic	CLP SOW ISM01 3MA	Two 4-ounce wide-mouth glass jars	Cool to 4 ± 2 C	NA/6 months
Soil	TCLP VOC/SVOC, ignitibility, corrosivity	CLP SOW SOM01.2 MA, 1030 MA, 1110A MA	Two 4-ounce wide-mouth glass jars	Cool to 4 ± 2 C	14/14 days (VOCs) 14/40 days (SVOCs) ASAP (ignitibility, corrosivity)
Soil	Lead and Arsenic (XRF)	EPA Method 6200	1 Gallon Ziplock bag	None	NA/6 months

Notes

CLP Contract Laboratory Program
MA Modified Analysis
NA Not Applicable

QAPP WORKSHEET #20 (CONTINUED)
FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

Matrix	Analytical Group	Analytical and Preparation SOP Reference ¹	Zone	Property Type	No. of Locations	No. of Samples	No. of Field Duplicates ²	No. of MS/MSDs ³	No. of Equipment Rinsates ⁵	Total No. of Samples ⁶
Soil	Lead and Arsenic/XRF	A-1	3	Industrial/Commercial	15	60	6	4	0	66
Soil	Lead and Arsenic/XRF	A-1	3	ROW	11	44	5	3	0	49
Soil	Lead and Arsenic/CLP	A-2	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	0	TBD ⁴
Soil	TCLP Lead and/or TCLP Arsenic/CLP	A-3	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	0	TBD ⁵
Soil	TCLP VOC/SVOC, ignitibility, corrosivity	A-4, A-5, A-6, A-7	TBD ⁷	TBD ⁷	TBD ⁷	TBD ⁷	TBD ⁷	TBD ⁷	0	TBD ⁷

Notes:

The number of locations are approximate.

A total of up to ten composite samples will be collected and analyzed for lead and arsenic by XRF from each residential property. A total of up to 20 composite samples will be collected for parks, schools, industrial/commercial, and ROWs.

MS/MSD Matrix Spike/Matrix Spike Duplicate
ROW Right of Way center divide.

- 1 Analytical and preparation SOPs are listed in Worksheet #23
- 2 Field duplicates are collected at a rate of 1 per 10 investigative samples of the same matrix.
- 3 MS/MSD samples are collected at a rate of 1 per 20 investigative samples of the same matrix.
- 4 If XRF data indicates that lead results are between 300-400 mg/kg (650-800 mg/kg for industrial/commercial), and/or if arsenic results are between 20-30 mg/kg, then the composite sample will be sent to a CLP laboratory for confirmation analysis.
- 5 If XRF data indicates that lead results are above 2000 mg/kg and/or if arsenic results are above 100 mg/kg, then the composite sample will be sent to a CLP laboratory for TCLP analysis.
- 6 Total sample count does not include MS/MSDs
- 7 If petroleum staining is visible in a soil sample, that sample will be submitted to a CLP laboratory for TCLP VOCs, TCLP SVOCs, Ignitibility, and Corrosivity.

**QAPP WORKSHEET #24
ANALYTICAL INSTRUMENT CALIBRATION TABLE**

(UFP Section 3.2 2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference¹
ICP/AES	Run five calibration mixed standard solutions and a blank	Each CCV analyzed shall reflect the conditions of analysis of all associated analytical samples (the preceding 10 analytical samples or the preceding analytical samples up to the previous CCV)	Deviation from the initial calibration verification. metals 90-110%	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria.	CLP Laboratory Analyst	A-2, A-3
GC/Mass Spectroscopy	VOCs: Run five calibration standard solutions and a blank SVOCs: Run five calibration standard solutions and a blank	12-hour continuing calibration acceptance criteria	Always, RRF ≥ 0.010 or per SOP Initial, RSD $\leq 20\%$ or 40%, depending on compound. Continuing. %D ≤ 25 or 40 depending on compound	Inspect the system for problems, clean the ion source, change the column, service the purge and trap device, and take CAs to achieve the technical acceptance criteria.	CLP Laboratory Analyst, Subcontracted laboratory Analyst (8270-SIM)	A-4, A-5

Notes

%D Percent difference
CCV Continuing calibration verification
CF Calibration factor
RRF Relative response factor
RSD Relative standard deviation

1 See Worksheet #23 for analytical methods

QAPP WORKSHEET #25
ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE
TESTING, AND INSPECTION TABLE

(UFP QAPP Section 3.2.2)

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference¹
ICP/AES	Daily Check, Initial Calibration Verification	Nebulizer, injection tube, flame optimization, gas supply, and detector	See A-2, A-3	See A-2, A-3	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria	CLP Laboratory Analyst	A-2, A-3
GC/Mass Spectroscopy	Daily Check, Instrument tune (4-bromofluorobenzene or decafluorotriphenylphosphine)	Injector syringe, injector septum, injector liner/seal, injector port, guard column, column splitter, analytical column, ion source, detector, traps, and gas supply	See A-1	See A-1	Inspect the system for problems, clean the ion source, change the column, and service the purge and trap device	CLP Laboratory Analyst	A-4, A-5

Note

1 See Worksheet #23 for identification of analytical methods.

QAPP WORKSHEET #28 (CONTINUED)
QC SAMPLES TABLE

Matrix	Soil
Analytical Group	TCLP VOA/CLP
Concentration Level	Low concentration
Sampling SOP	S-1, S-2
Analytical Method/ SOP Reference	A-4
Sampler's Name/ Organization	TBD/SulTRAC
Analytical Organization	CLP Laboratory
No. of Sampling Locations	See Worksheet #18

QC Sample	Frequency/ Number	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1 per extraction batch samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. If sufficient volume is not available, reanalyze affected extracts.	Laboratory Analyst	Accuracy/Bias Contamination	No target compounds > QL
MS/MSD	1 per extraction batch samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. Otherwise, analyze laboratory control sample to see if problem is analysis or sample.	Laboratory Analyst	Accuracy and Precision	%R and RPD as presented in Worksheet #12
Deuterated Monitoring Compounds	All samples	Reanalyze sample. If upon reanalysis, the monitoring compound meets criteria, report reanalysis results. If upon reanalysis, the monitoring compound does not meet criteria, the results are reported in the narrative.	Laboratory Analyst	Accuracy	%R as presented in Worksheet #12

QAPP WORKSHEET #28 (CONTINUED)
QC SAMPLES TABLE

Matrix	Soil
Analytical Group	TCLP SVOA/CLP
Concentration Level	Low concentration
Sampling SOP	S-1, S-2
Analytical Method/ SOP Reference	A-5
Sampler's Name/ Organization	TBD/SulTRAC
Analytical Organization	CLP Laboratory
No. of Sampling Locations	See Worksheet #18

QC Sample	Frequency/ Number	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1 per extraction batch samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. If sufficient volume is not available, reanalyze affected extracts.	Laboratory Analyst	Accuracy/Bias Contamination	No target compounds > QL
MS/MSD	1 per extraction batch samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. Otherwise, analyze laboratory control sample to see if problem is analysis or sample.	Laboratory Analyst	Accuracy and Precision	%R and RPD as presented in Worksheet #12
Deuterated Monitoring Compounds	All samples	Reanalyze sample. If upon reanalysis, the monitoring compound meets criteria, report reanalysis results. If upon reanalysis, the monitoring compound does not meet criteria, the results are reported in the narrative.	Laboratory Analyst	Accuracy	%R as presented in Worksheet #12

**QAPP WORKSHEET #30
ANALYTICAL SERVICES TABLE**

(UFP QAPP Section 3.5.2.3)

Matrix	Analytical Group	Concentration Level	Sampling Location/ ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person, and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Soil	Lead and Arsenic	Multi-concentration	See Worksheet #18	A-2	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	TCLP Lead and Arsenic	Multi-concentration	See Worksheet #18	A-3	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	TCLP VOCs	Multi-concentration	See Worksheet #18	A-4	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	TCLP SVOCs	Multi-concentration	See Worksheet #18	A-5	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	Ignitibility	Multi-concentration	See Worksheet #18	A-6	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	Corrosivity	Multi-concentration	See Worksheet #18	A-7	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5

Notes

Analytical SOPs listed in Worksheet #23

QAPP WORKSHEET #35
VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

(UFP QAPP Section 5.2.2)

Step Iia/Iib	Validation Input	Description	Responsible for Validation (Name, Organization) ¹
Iia	Chain of custody	Examine traceability of samples from sample collection to sample analysis	EPA (CADRE), Analytical Coordinator, SulTRAC
Iia	Holding time	Confirm that holding time requirements are met	EPA (CADRE), Chemist ² , SulTRAC
Iia	Instrument calibration	Confirm that instrument calibration requirements are met	EPA (CADRE), Chemist ² , SulTRAC
Iia	Analytical method	Confirm that analytical methods specified in QAPP have been used for sample analysis	EPA (CADRE), Chemist ² , SulTRAC
Iib	Performance criteria	Confirm that QC samples meet specified performance criteria; document any deviations in data evaluation summary report	EPA (CADRE), Chemist ² , SulTRAC

Notes

- 1 EPA is responsible for conducting computer-aided data review and evaluation (CADRE) of analytical data generated by the CLP laboratory. EPA data validation and review will be conducted by ESAT in accordance with CLP National Functional Guidelines (NFG) for Inorganic Superfund Data Review (U.S. EPA 2010).
- 2 ~~100% of the CLP data will undergo CADRE evaluation, however only 20% (1 data package in 5) will undergo data validation by an EPA (ESAT) chemist. No TCLP data will be validated; only total lead and arsenic results.~~

**QAPP WORKSHEET #36
VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE**

(UFP QAPP Section 5.2.2)

Step IIA/IIB	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (Title and Organization) ¹
IIa	Soil	Arsenic and Lead	Multi	CADRE criteria and NFG	CADRE validation (EPA) and review of case narrative by SulTRAC
IIb	Soil	Arsenic and Lead	Multi	CADRE criteria and NFG	CADRE validation (EPA) and review of case narrative by SulTRAC

Notes

¹ EPA is responsible for conducting computer-aided data review and evaluation (CADRE) of analytical data generated by the CLP laboratory. EPA data validation and review will be conducted by ESAT in accordance with CLP National Functional Guidelines (NFG) for Inorganic Superfund Data Review (U.S. EPA 2010). 100% of the CLP data will undergo CADRE evaluation, however only 20% (1 data package in 5) will undergo data validation by an EPA (ESAT) chemist. No TCLP data will be validated, only total lead and arsenic results.

QAPP WORKSHEET #11 (CONTINUED)
PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

How much data will be collected (number of samples for each analytical group, matrix, and concentration)? SulTRAC will collect 8 to 10 samples from each of the residential properties and analyze them for lead and arsenic by XRF. SulTRAC will collect a maximum of 20 samples from each of the industrial/commercial, school, park, and right-of-way properties and analyze them for lead and arsenic by XRF. Select samples as noted in sections above will be sent to CLP for confirmation analysis.

In addition, QC samples will be collected and analyzed, including duplicates, matrix spikes (MS), and matrix spike duplicates (MSD).

Where, when, and how should the data be collected/generated? Sampling activities will take place during Fall 2014- Fall 2015 at the USS Lead Site, weather permitting.

Who will collect and generate the data? SulTRAC will collect the samples discussed herein. Field personnel will conduct field analysis using an Innov-X XRF analyzer. A CLP laboratory will analyze confirmation samples for total lead and arsenic and/or TCLP (MA) samples for lead and/or arsenic. All modified analyses requests will be submitted 3 weeks in advance to the EPA Sample Management Office (SMO).

How will the data be reported? Data will be reported by the CLP laboratory using standard CLP data reporting techniques. Data will be reported in electronic and hard-copy form. SulTRAC will conduct limited data validation of CLP laboratory data in addition to standard CADRE data analysis performed by CLP Laboratory. Field data will be uploaded and maintained in the project specific electronic database.

How will the data be archived? Electronic and hard copies of CLP analytical data will be archived by the CLP laboratory. Field data (notebooks, sampling sheets, etc.), XRF results, and laboratory analytical data will be scanned and electronic copies will be maintained at SulTRAC's Chicago office. SulTRAC will also provide 10-year data storage.

**QAPP WORKSHEET #12
 MEASUREMENT PERFORMANCE CRITERIA TABLE**

Matrix	Soil/Solids				
Analytical Group	Lead and Arsenic/XRF				
Concentration Level	Multi-concentration				
Sampling Procedure¹	Analytical Method SOP²	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
S-1, S-2	A-1	Precision	RPD \leq 50%	Field duplicate	S & A
S-1, S-2	A-1	Accuracy/Bias Contamination	%R per manufacturer instructions	Calibration Check Standard	S & A
S-1 S-2	A-1	Completeness	>90%	Data Completeness defined as data not qualified as rejected after validation	S&A

Notes:

DQI Data quality indicator
 QL Quantitation limit
 %R Percent recovery
 RPD Relative percent difference
¹ Reference number from QAPP Worksheet #21
² Reference number from QAPP Worksheet #23

QAPP WORKSHEET #12 (CONTINUED)
MEASUREMENT PERFORMANCE CRITERIA TABLE

Matrix	Soil/Solids				
Analytical Group	Lead and Arsenic/CLP				
Concentration Level	Multi-concentration				
Sampling Procedure¹	Analytical Method SOP²	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
S-1, S-2	A-2	Precision	RPD ≤ 50%	Field duplicate	S & A
S-1, S-2	A-2	Accuracy/Bias: Contamination	Pb and As < QL	Rinsate blank	S & A
S-1, S-2	A-2	Accuracy/Bias	Pb and As: 75-125 %R	MS	A
S-1, S-2	A-2	Precision	Pb and As: < 20% RPD	Laboratory duplicate	A
S-1, S-2	A-2	Sensitivity/Contamination	Pb and As <QL	Method blank	A
S-1, S-2	A-2	Completeness	>90%	Data Completeness defined as data not qualified as rejected after validation	S&A

Notes:

The measurement performance criteria listed above is for total lead and arsenic by CLP SOW ISM01 3 TCLP method will follow the same criteria.

DQI Data quality indicator

QL Quantitation limit

%R Percent recovery

RPD Relative percent difference

¹ Reference number from QAPP Worksheet #21

² Reference number from QAPP Worksheet #23

**QAPP WORKSHEET #13
SECONDARY DATA CRITERIA AND LIMITATIONS TABLE**

(UFP QAPP Section 2.7)

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Source (Originating Org, Data Types, data Generation/Collection Dates)	How data will be used	Limitation on Data Use
XRF soil data	USEPA. Final Report on X-Ray Fluorescence Field Study of Selected Properties in Vicinity of Former USS Lead Refinery Facility, East Chicago, Indiana. November 2003.	USEPA; soil XRF data, collected 2003	Data will be used qualitatively to select sampling locations in addition to background data usage.	None
Soil metals data	USEPA. Draft Characterization of Lead and Other Metals in Soil in the Vicinity of the USS Lead Site, East Chicago, Indiana. April 20, 2004.	USEPA, XRF and laboratory metals data collected 2002 and 2004.	Data will be used qualitatively to select sampling locations in addition to background data usage.	None
Soil metals data	STN. Draft Site Assessment Letter Report, USS Lead Site November 8, 2007.	STN. Soil XRF data, collected 2007.	Data will be used qualitatively to select sampling locations in addition to background data usage.	None
Soil metals data	Final Remedial Investigation Report US Smelter and Lead Refinery (USS Lead) Superfund Site. Lake County, Indiana. June 2012	SulTRAC, collected in 2009 and 2010.	Data will be used qualitatively to select sampling locations in addition to background data usage.	None

QAPP WORKSHEET #14 SUMMARY OF PROJECT TASKS

(UFP QAPP Section 2.8.1)

Sampling Tasks:

1. Collect 5-point composite soil samples from approximately 1,150 properties (combination of residential, industrial, parks, and schools) from four depth intervals: 0-6, 6-12, 12-18, 18-24, and 24-30 inches bgs and analyze them for total lead and arsenic by XRF. The deepest interval of 24-30 inches bgs will only be collected if native sand had not be encountered.
2. If XRF indicates that total lead concentrations for residential soils (including schools and parks) are within the range of 300-400 mg/kg and/or total arsenic concentrations are within 20-30 mg/kg then the soil sample will be sent to a CLP laboratory for confirmation analysis. If XRF indicates that total lead concentrations for industrial/commercial soils are within the range of 650-800 mg/kg and/or total arsenic concentrations are within 20-30 mg/kg then the soil sample will be sent to a CLP laboratory for confirmation analysis. In addition, if total lead concentrations are above 400 mg/kg in residential soils (including parks and schools) or 800 mg/kg in industrial/commercial soils, and/or if arsenic concentrations are above 26 mg/kg, then the soil sample will be sent to a CLP laboratory for TCLP analysis.
3. Log activities and tasks in field notebook and sampling forms.
4. Prepare sample documentation such as chain-of-custody forms, sample labels, custody seals, etc.

Analysis Tasks: SulTRAC will analyze soil samples by XRF for total lead and arsenic. A CLP laboratory will analyze select field samples for total lead and arsenic in addition to TCLP for lead and/or arsenic.

QC Tasks: The following QC samples will be collected and analyzed during the sampling event: field duplicates and MS/MSD samples.

Secondary Data: See Worksheet #13

Data Management Tasks: Analytical data will be archived in an electronic database after validation.

Documentation and Records: All samples collected will be documented in a logbook using a ballpoint pen. The time of collection, identification number, sampling location, field observations, sampler's name, and analyses will be recorded in the logbook for each sample. Each page of the logbook will be dated, numbered, and signed by SulTRAC personnel. Electronic copies of field data records will be maintained at SulTRAC's Chicago office. SulTRAC will follow custody procedures outlined in SulTRAC's program-level QAPP for the RAC 2 contract. Further specifications are described in the FSP.

Assessment/Audit Tasks: Not applicable.

QAPP WORKSHEET #14 (CONTINUED)
SUMMARY OF PROJECT TASKS

Data Review Tasks: EPA will perform CADRE for all CLP data and will prepare a case narrative detailing any issues or inconsistencies discovered. SulTRAC will conduct limited data validation of all CLP analytical data. The SulTRAC project manager will review the case narrative and will detail any analytical issues that may potentially affect data quality and determine action if needed in consultation with EPA.

QAPP WORKSHEET #15
REFERENCE LIMITS AND EVALUATION TABLE

(UFP QAPP Section 2.8.1)

Reference Limits Table – Soil

Analytical Group	Analyte	Cas Number	PAL(mg/kg)	CRQL (mg/kg)
TAL Metals/CLP	Arsenic	7440-38-2	26	10
TAL Metals/CLP	Lead	7439-92-1	340 (670)	1.0

Notes

The lead clean up goal is 400 mg/kg (800 mg/kg for industrial/commercial) according to the EPA Superfund Lead-Contaminated Residential Sites Handbook (EPA 2003). The PAL was set to 340 mg/kg (640 industrial/commercial) to account for negative bias and was based on XRF correlation data obtained during the RI completed by SulTRAC in June 2012. (SulTRAC 2012)

The arsenic clean up goal was set at the 95% upper tolerance limit (UTL) for background arsenic presented in the RI completed by SulTRAC in RI Report. (SulTRAC 2012)

CAS Chemical Abstract Services
CRQL Contract-required quantitation limit
mg/kg Milligram per kilogram

QAPP WORKSHEET #16
PROJECT SCHEDULE/TIMELINE TABLE

(UFP QAPP Section 2.8.2)

Activity	Organization	Date		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
Preliminary Remedial Design	SulTRAC	October 2014	December 2014	Preliminary Remedial Design	12/31/2014
Pre-Final Remedial Design	SulTRAC	January 2015	March 2015	Preliminary Remedial Design	3/31/2014
Final Remedial Design	SulTRAC	March 2015	August 2015	Preliminary Remedial Design	8/31/2015

QAPP WORKSHEET #17 SAMPLING DESIGN AND RATIONALE

(UFP QAPP Section 3.1.1)

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be collected, and the sampling frequency (including seasonal considerations). (May refer to map or Worksheet #18 for details).

The remedial design sampling will include the collection of XRF soil samples on each property in OU1 that does not already have sufficient data to make remedial design decisions. Eighty-nine properties were sampled during the RI and thirty-one properties have been remediated by START and the City of East Chicago. SulTRAC will collect samples from approximately 1,150 properties within OU1. The field team will attempt to distribute the sample points to provide even coverage of the property/yard sampled. SulTRAC will mobilize to OU1 to conduct an XRF soil investigation for metals. The goal of the screening is to identify residential properties above the cleanup goals for lead and arsenic and provide data adequate to prepare remedial designs.

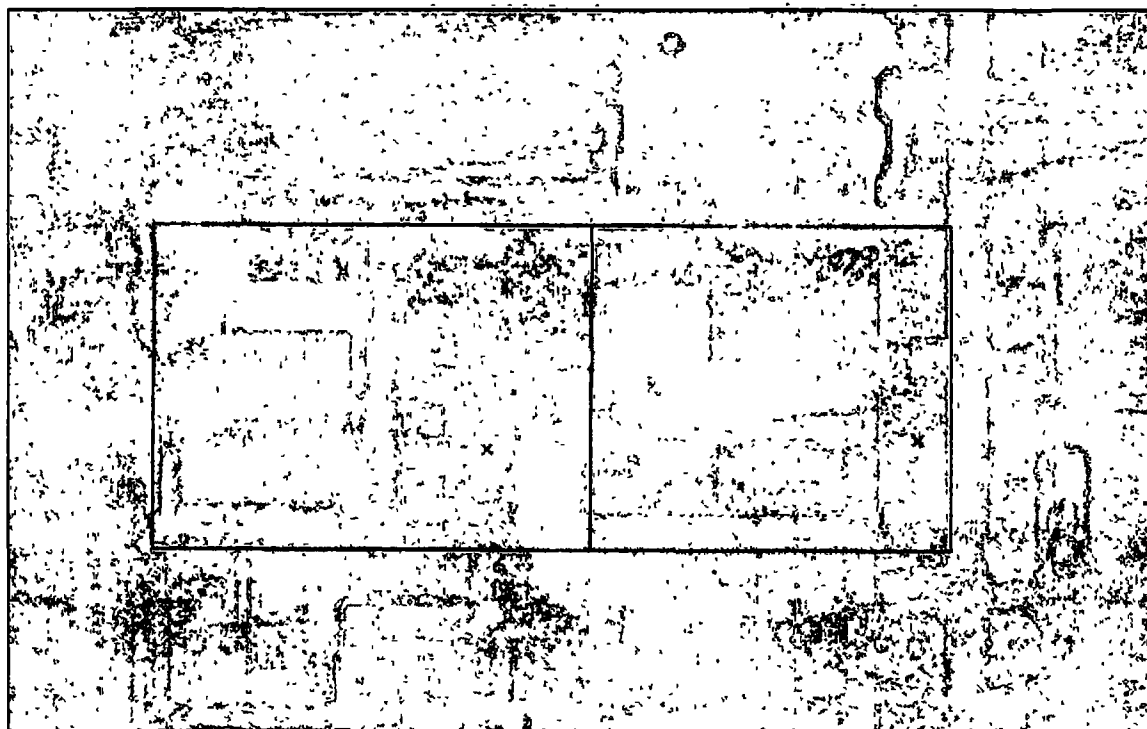
Residential Properties:

Residential properties with a structure on the property will be divided into front and back yards, and a 5 point composite sample will be collected from each front yard and each back yard by depth interval. Drip zones will not be sampled separately. If there are side yards, the 5 point composite may include locations from the side yards. Four depth-discrete 5 point composite samples will be collected from each yard, including 5-point composite samples from 0-6 inches, 6-12 inches, 12-18 inches and 18-24 inches bgs, in an X shaped pattern, with one sample aliquot from each end point of the X and one sample aliquot from the center, as shown in the figure below. The 5 individual aliquots from each point will then be mixed into a depth specific composite sample for analysis by XRF. Typically, eight composite samples will be collected at each residential property (four from the front yard and four from the back yard). If native sand is not encountered in the 18-24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Any composite sample from a yard with XRF readings for lead between 300 ppm and 400 ppm and/or XRF readings for arsenic between 20 ppm and 30 ppm will be submitted to CLP for total lead and/or total arsenic analysis. Any composite sample from a yard with XRF readings for lead or arsenic above cleanup goals will be submitted to CLP for TCLP lead analysis. The cleanup goals are 400 ppm for lead at residential properties, parks, and schools, 800 ppm for lead at

QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

industrial/commercial properties, and 26 ppm for arsenic.

EXAMPLE COMPOSITE SAMPLE LOCATIONS - RESIDENTIAL PROPERTY.

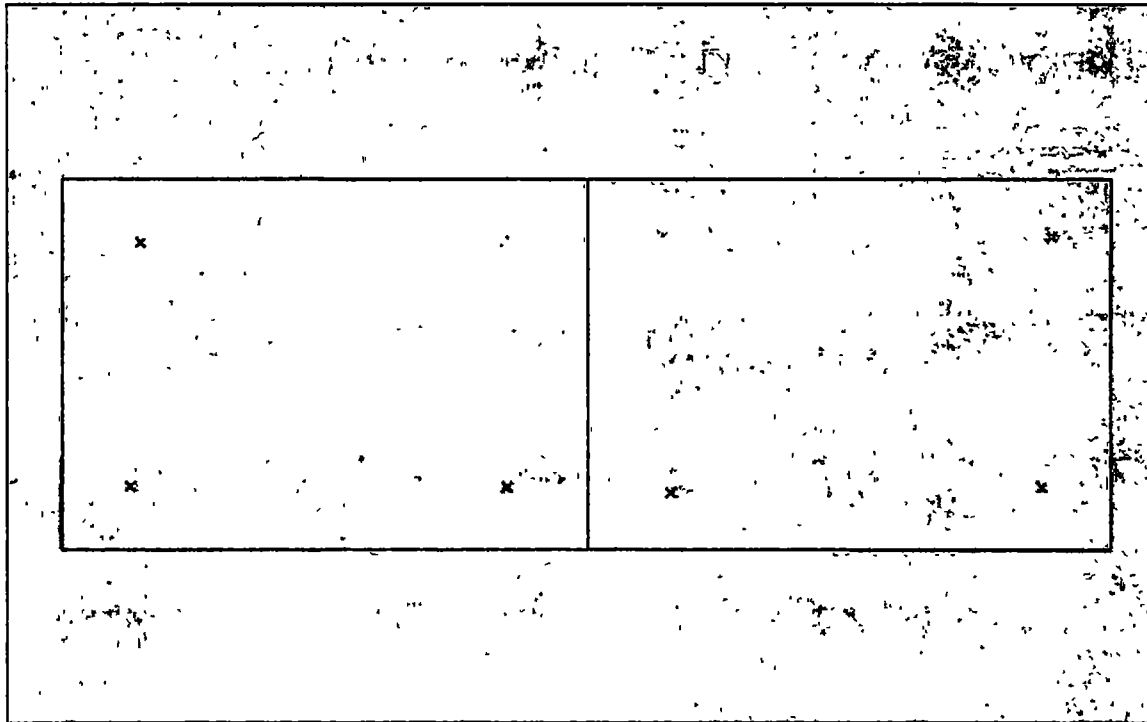


Vacant Lots:

Vacant lots will be divided into two halves to correspond with front and back yards. Four 5 point composites will be collected from each half, and each composite sample will be screened using XRF. If native sand is not encountered in the 18-24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Each yard will be sampled in the same manner as described above for residential properties.

QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - VACANT LOT

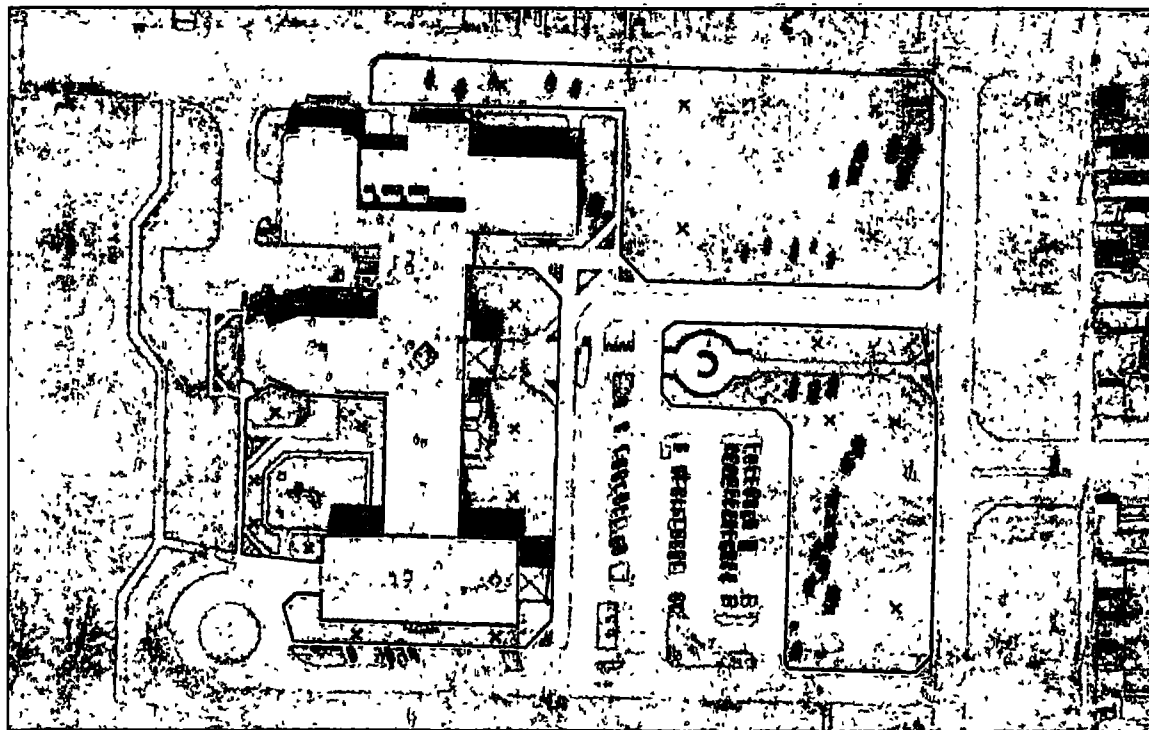


Schools

If sampling at schools becomes necessary, school properties will be sampled by dividing the property into four quadrants. If native sand is not encountered in the 18-24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Each quadrant will be sampled in the same manner as described above for residential properties.

QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - SCHOOL

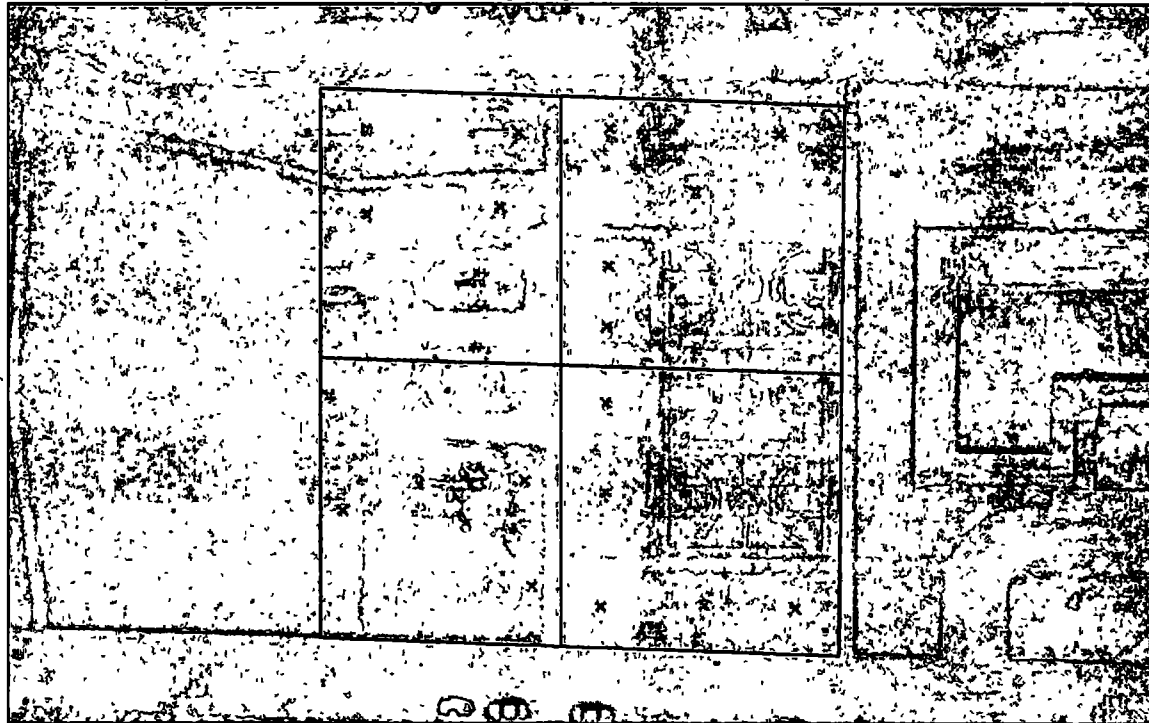


Parks

The known parks within OU1 were sampled as part of the RI. If sampling in recreational parks is necessary, parks will be sampled by dividing the property into four quadrants of approximately equal area. If native sand is not encountered in the 18 24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Each quadrant will be sampled in the same manner as described above for residential properties.

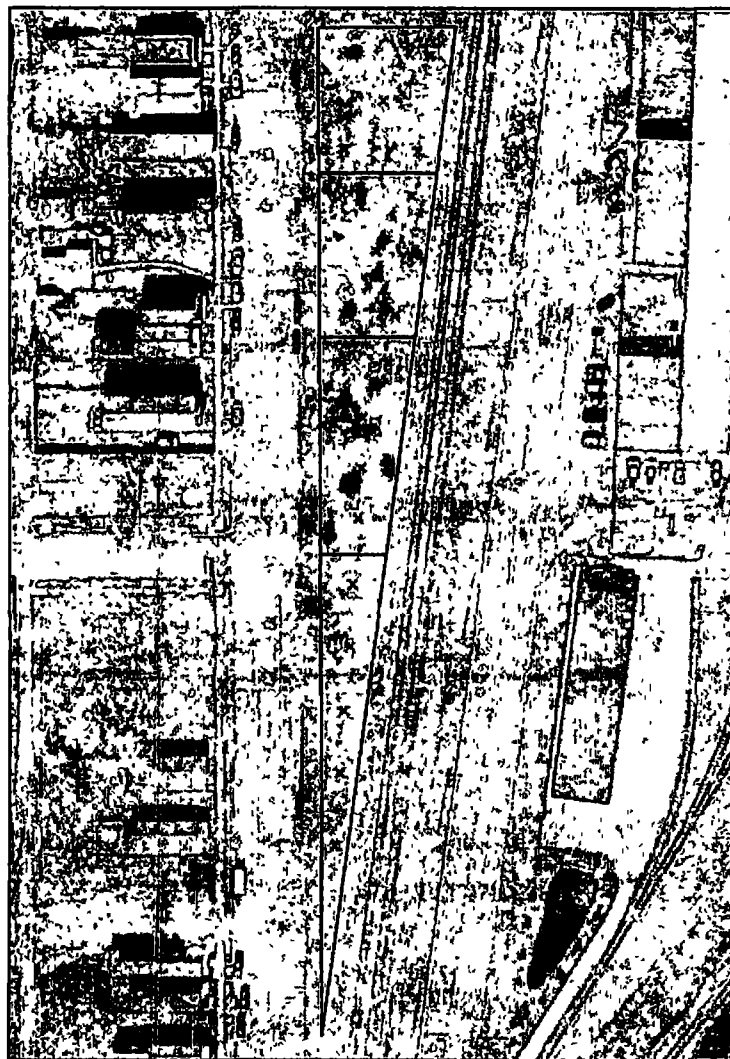
QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - PARK 1



QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - PARK 2



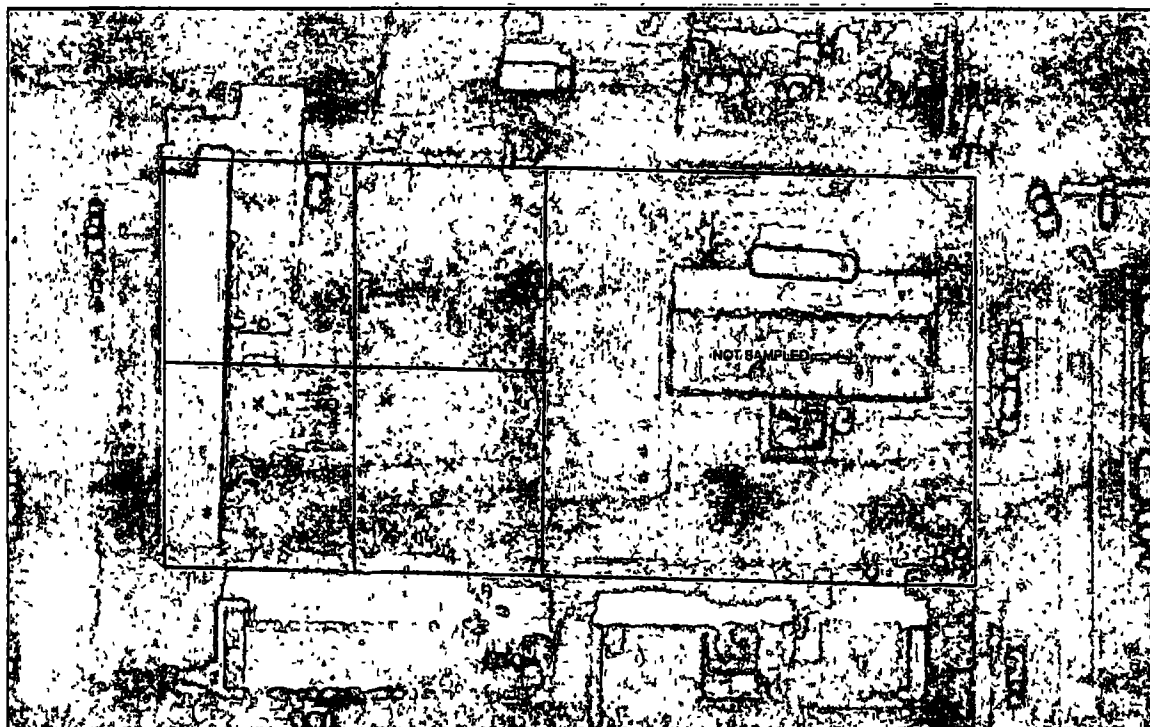
QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

Industrial/Commercial properties and Right-of-Ways

Industrial/Commercial properties and Right-of-Ways will be sampled by dividing the property into four quadrants of approximately equal area. Sampling will only be conducted in grassy areas or areas with exposed soil. No samples will be collected beneath paved areas or areas covered by concrete. If native sand is not encountered in the 18-24 inches bgs sampling interval, an additional depth interval composite sample will be collected from 24-30 inches bgs for analysis of lead and arsenic. Each quadrant will be sampled in the same manner as described above for residential properties. Any composite sample from a quadrant with XRF readings for lead between 650 ppm and 800 ppm and/or XRF readings for arsenic between 20 ppm and 30 ppm will be submitted to CLP for total lead and/or total arsenic analysis.

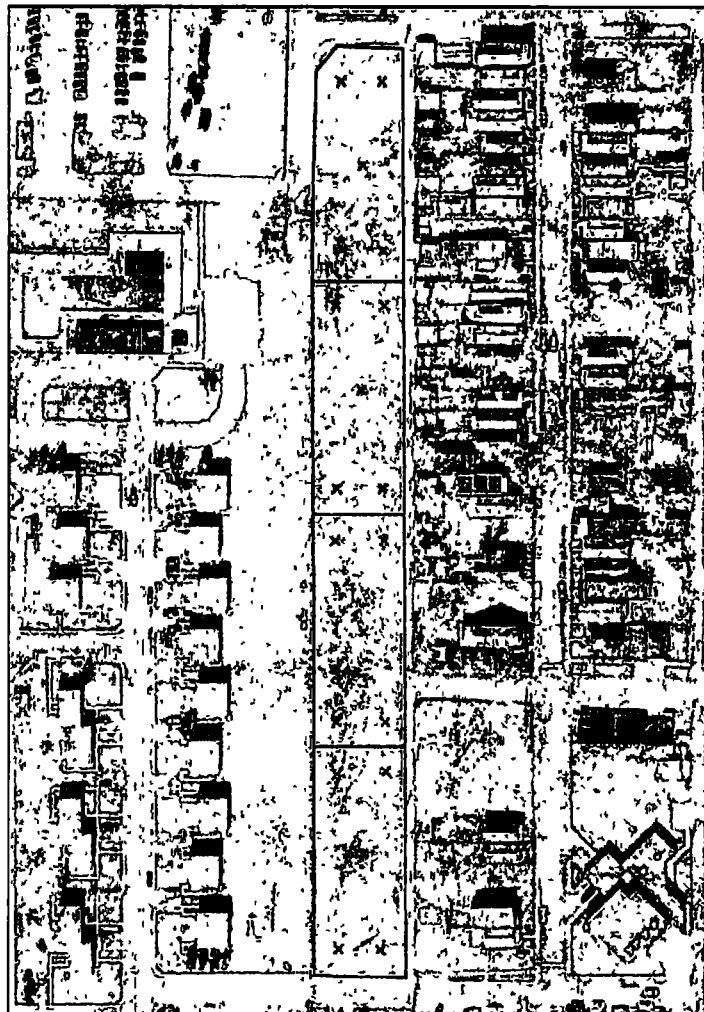
QAPP WORKSHEET #17 (CONTINUED) SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - COMMERCIAL/INDUSTRIAL



QAPP WORKSHEET #17 (CONTINUED)
SAMPLING DESIGN AND RATIONALE

EXAMPLE COMPOSITE SAMPLE LOCATIONS - RIGHT OF WAY



QAPP WORKSHEET #18
SAMPLING LOCATIONS/IDS, SAMPLE DEPTHS, SAMPLE ANALYSES
AND SAMPLING PROCEDURES TABLE

(UFP QAPP Section 3.1.1)

Sampling Location ¹ / ID Number	Matrix	Depth (inches bgs)	Analytical Group	Sampling SOP Reference ²
Approximately 1150 locations, composite samples from five depths	Soil ³	0-6 6-12 12-18 18-24 24-30*	Lead by XRF field analysis (1230 samples)	S-1, S-2, S-3
TBD ⁴	Soil ³	TBD ⁴	CLP SOW ISM01.3(Total Lead and Arsenic)	S-1, S-3
TBD ⁵	Soil ³	TBD ⁵	Modified Analysis (MA) CLP SOW ISM01.3 (TCLP Lead and Arsenic)	S-1, S-3

Notes:

ID Identification

*The 24-30 inches bgs depth interval will only be collected if native sand has not been encountered in the 18-24 inches bgs interval.

- 1 See Figure B-1 for residential portion of study area.
- 2 See Worksheet #21 for a list of sampling methods S-1 through S-3
- 3 Samples will be collected from hand-augered soil borings.
- 4 If XRF data indicates that lead results are between 300-400 mg/kg for residential properties (650-800 mg/kg for industrial/commercial), and/or if arsenic results are between 20-30 mg/kg, then the composite sample will be sent to a CLP laboratory for confirmation analysis.
- 5 If XRF data indicates that lead results are above 400 mg/kg for residential soils (including parks and schools) or 800 mg/kg for industrial/commercial soils, and/or if arsenic results are above 26, then the composite sample will be sent to a CLP laboratory for TCLP analysis.

QAPP WORKSHEET #19
ANALYTICAL METHODS, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES TABLE

(UFP QAPP Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)¹
Soil	Lead and Arsenic	CLP SOW ISM01.3	Two 4-ounce wide-mouth glass jars	Cool to 4 ± 2 C	NA/6 months
Soil	TCLP Lead and TCLP Arsenic	CLP SOW ISM01.3MA	Two 4-ounce wide-mouth glass jars	Cool to 4 ± 2 C	NA/6 months
Soil	Lead and Arsenic (XRF)	EPA Method 6200	1 Gallon Ziplock bag	None	NA/6 months

Notes

CLP Contract Laboratory Program
 MA Modified Analysis
 NA Not Applicable

QAPP WORKSHEET #20
FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

(UFP QAPP Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation SOP Reference ¹	Zone	Property Type	No. of Locations	No. of Samples	No. of Field Duplicates ²	No. of MS/MSDs ³	No. of Equipment Rinsates ⁵	Total No. of Samples ⁶
Soil	Lead and Arsenic/XRF	A-1	1	Residential	82	820	82	45	0	902
Soil	Lead and Arsenic/XRF	A-1	1	Park	2	40	4	3	0	44
Soil	Lead and Arsenic/XRF	A-1	1	School	1	20	2	2	0	22
Soil	Lead and Arsenic/XRF	A-1	1	Industrial/Commercial	2	40	4	3	0	44
Soil	Lead and Arsenic/XRF	A-1	1	ROW	0	0	0	0	0	0
Soil	Lead and Arsenic/XRF	A-1	2	Residential	495	4950	495	272	0	5445
Soil	Lead and Arsenic/XRF	A-1	2	Park	2	40	4	3	0	44
Soil	Lead and Arsenic/XRF	A-1	2	School	0	0	0	0	0	0
Soil	Lead and Arsenic/XRF	A-1	2	Industrial/Commercial	57	1140	114	63	0	1254
Soil	Lead and Arsenic/XRF	A-1	2	ROW	6	120	12	7	0	132
Soil	Lead and Arsenic/XRF	A-1	3	Residential	476	4760	476	262	0	5236
Soil	Lead and Arsenic/XRF	A-1	3	Park	1	20	2	2	0	22
Soil	Lead and Arsenic/XRF	A-1	3	School	0	0	0	0	0	0

QAPP WORKSHEET #20 (CONTINUED)
FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

Matrix	Analytical Group	Analytical and Preparation SOP Reference ¹	Zone	Property Type	No. of Locations	No. of Samples	No. of Field Duplicates ²	No. of MS/MSDs ³	No. of Equipment Rinsates ⁵	Total No. of Samples ⁶
Soil	Lead and Arsenic/XRF	A-1	3	Industrial/Commercial	15	60	6	4	0	66
Soil	Lead and Arsenic/XRF	A-1	3	ROW	11	44	5	3	0	49
Soil	Lead and Arsenic/CLP	A-2	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	TBD ⁴	0	TBD ⁴
Soil	TCLP Lead and/or TCLP Arsenic/CLP	A-2	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	TBD ⁵	0	TBD ⁵

Notes

The number of locations are approximate

A total of up to ten composite samples will be collected and analyzed for lead and arsenic by XRF from each residential property. A total of up to 20 composite samples will be collected for parks, schools, industrial/commercial, and ROWs.

MS/MSD Matrix Spike/Matrix Spike Duplicate
ROW Right of Way center divide.

- 1 Analytical and preparation SOPs are listed in Worksheet #23.
- 2 Field duplicates are collected at a rate of 1 per 10 investigative samples of the same matrix.
- 3 MS/MSD samples are collected at a rate of 1 per 20 investigative samples of the same matrix.
- 4 If XRF data indicates that lead results are between 300-400 mg/kg (650-800 mg/kg for industrial/commercial), and/or if arsenic results are between 20-30 mg/kg, then the composite sample will be sent to a CLP laboratory for confirmation analysis
- 5 If XRF data indicates that lead results are above 400 mg/kg in residential soils (including parks and schools) or 800 mg/kg for industrial/commercial soils, and/or if arsenic results are above 26 mg/kg, then the composite sample will be sent to a CLP laboratory for TCLP analysis.
- 6 Total sample count does not include MS/MSDs

QAPP WORKSHEET #21
PROJECT SAMPLING SOP REFERENCES TABLE

(UFP QAPP Section 3:1.2)

Reference Number	Title, Revision, Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
S-1	Soil Sampling, Revision No. 2, SOP 005 August 2013	SulTRAC	Spoon or spatulas, trowel, split-spoon sampler, coring tools	N	None
S-2	Field X-Ray Fluorescence Measurement Number: SESDPROC-107IR2. Revision 2. December 2011	EPA Region 4	Field Portable Innov-X XRF Analyzer	N	None
S-3	General Equipment Decontamination SOP No. 002, Revision No. 01. May 2013	Sullivan International Group	Scrub brushes, large wash tubs or buckets, Alconox, distilled water	N	None
S-4	Recording Notes in Field Logbook SOP. No. 003, Revision No. 01. May 2013	Sullivan International Group	Logbook, ball point pen.	N	None
S-5	Packaging, Shipping, and Custody of Samples SOP NO.001, Revision No. 02. May 2013	Sullivan International Group	Computer, printer, labels, custody seals, zip locks, trash bags, ice.	N	None

QAPP WORKSHEET #22
FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP QAPP Section 3.1.2.4)

Field Equipment	Calibration Activity ¹	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
Innov-X XRF Analyzer ²	Per manufacturer's instructions	Daily before first field measurement	Standard results must be within $\pm 30\%$ of true value	Repeat calibration; correct measurements for drift if necessary	Field team leader or field team members	S-2	None

Notes:

CA Corrective Action
 ppm Part per million

- 1 The field equipment will be calibrated per manufacturer's instructions
 2 Instrument accuracy will be verified using manufacturer supplied calibration blanks.

QAPP WORKSHEET #23
ANALYTICAL SOP REFERENCES TABLE

(UFP QAPP Section 3.2.1)

Reference Number	Title, Revision, Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
A-1	EPA Method 6200. Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. Revision 0, February 2007.	Definitive	Lead and Arsenic	XRF	SulTRAC	No
A-2	CLP SOW ISM01.3 for Inorganic Analysis, Multi-Media, Multi-Concentration 2010	Definitive	Lead and Arsenic	ICP/AES	CLP Laboratory	No
A-2	Modified analysis CLP SOW ISM01.3MA for TCLP of Inorganic Analysis, Multi-Media, Multi-Concentration 2010	Definitive	Lead and Arsenic	ICP/AES	CLP Laboratory	Yes

Notes:

TCLP analysis would a modified analysis of SOP reference number A-2

AES Atomic emission spectroscopy
NA Not applicable
SOP Standard Operating Procedure

QAPP WORKSHEET #24
ANALYTICAL INSTRUMENT CALIBRATION TABLE

(UFP Section.3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference¹
ICP/AES	Run five calibration mixed standard solutions and a blank	Each CCV analyzed shall reflect the conditions of analysis of all associated analytical samples (the preceding 10 analytical samples or the preceding analytical samples up to the previous CCV)	Deviation from the initial calibration verification: metals 90-110%	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria.	CLP Laboratory Analyst	A-2

Notes:

%D Percent difference
CCV Continuing calibration verification
CF Calibration factor
RRF Relative response factor
RSD Relative standard deviation

-1 See Worksheet #23 for analytical methods.

QAPP WORKSHEET #25
ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE
TESTING, AND INSPECTION TABLE

(UFP QAPP Section 3.2.2)

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference¹
ICP/AES	Daily Check, Initial Calibration Verification	Nebulizer, injection tube, flame optimization, gas supply, and detector	See A-2	See A-2	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria	CLP Laboratory Analyst	A-2

Note.

1 See Worksheet #23 for identification of analytical methods.

**QAPP WORKSHEET #26
SAMPLE HANDLING SYSTEM**

(UFP QAPP Section 3.3)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field sampling personnel/SulTRAC
Sample Packaging (Personnel/Organization): Field sampling personnel/SulTRAC
Coordination of Shipment (Personnel/Organization): Field sampling personnel/SulTRAC
Type of Shipment/Carrier: Cooler packed with ice and packing material such as bubble wrap/FedEx or other overnight courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Laboratory personnel/CLP laboratory
Sample Custody and Storage (Personnel/Organization): Laboratory personnel/CLP laboratory
Sample Preparation (Personnel/Organization): Laboratory personnel/CLP laboratory
Sample Determinative Analysis (Personnel/Organization): Laboratory personnel/CLP laboratory
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): See Worksheet #27
SAMPLE DISPOSAL
Personnel/Organization: Laboratory personnel/CLP laboratory
Number of Days from Analysis: To be determined (or in accordance with individual laboratory SOP)

QAPP WORKSHEET #27 SAMPLE CUSTODY REQUIREMENTS

UFP QAPP Section 2.3.3

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to the laboratory): SulTRAC will use EPA's Scribe software to manage sample collection, documentation, chain-of-custody, and reporting. Field personnel will input data into Scribe and then use the software to generate sample labels, bottle tags, and chain-of-custody forms to track samples from the field to the laboratory. Because Scribe captures sample management information electronically, the information is easily exportable to databases or various reporting formats.

Chain-of-custody forms will be signed in ink by the samplers and the individual relinquishing custody. SulTRAC will then follow the sample packaging and shipment procedures summarized below to ensure that samples arrive at the laboratory with the chain of custody intact.

1- Immediately after sample collection, sample containers will be labeled with the appropriate identifiers. Clear tape will be placed over the sample container's labels to prevent smearing.

2- The samples will be placed in Ziploc plastic bags and then in a cooler containing double-sealed bags of ice and maintained at 4 °C. The cooler will remain in a secured area or in view of the sampler until it is properly sealed for shipment to the laboratory.

3- Prior to shipping, the chain-of-custody forms, airbills, and all other relevant documents will be completed. Chain-of-custody forms will be sealed in plastic bags and taped to the inside of the cooler lid. Cushioning material, such as bubble-wrap, will be placed in the cooler.

4- A temperature blank consisting of a jar or vial containing water will be included in every cooler to be used by the laboratory to determine the cooler temperature at the time of sample receipt.

5- The shipping cooler will then be sealed with tape and custody seals in a manner that will indicate whether the cooler was opened. The preferred procedure includes placement of custody seals at diagonally opposite corners of the cooler. The custody seals will be covered with clear plastic tape or strapping tape.

The field sampler is personally responsible for the care and custody of the samples until they are transferred to other personnel or properly dispatched to an overnight carrier or directly to a laboratory. When transferring possession of the samples, the individuals relinquishing and receiving the samples sign, date, and note the time of transfer on the chain-of-custody form. Commercial carriers are not required to sign off on the chain-of-custody form as long as the form is sealed inside the sample cooler and the custody seals remain intact.

QAPP WORKSHEET #27 (CONTINUED) SAMPLE CUSTODY REQUIREMENTS

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): The laboratory sample custodian will receive all incoming samples and indicate receipt by signing the accompanying custody forms and retaining copies of the signed forms as permanent records. The laboratory sample custodian will record all pertinent information concerning the sample, including the persons delivering and receiving the sample, the date and time received, the method by which the sample was transmitted to the laboratory, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature; or other relevant remarks), the sample identification number, and any unique laboratory identification number associated with the sample. This information should be entered into a computerized laboratory information management system (LIMS).

The laboratory will provide a secure storage area, restricted to authorized personnel, for all samples. Only the custodian can distribute samples to laboratory personnel authorized to conduct the required analyses. Laboratory analytical personnel are responsible for the care and custody of the sample upon receipt.

At the completion of sample analysis, any unused portion of the sample, together with all identifying labels, will be returned to the custodian. The returned tagged sample will be retained in secure storage until the custodian receives permission to dispose of the sample. Sample disposal will occur only on the order of the laboratory project manager in consultation with EPA or SulTRAC or when it is certain that the information is no longer required or the samples have deteriorated. Likewise, laboratory records will be maintained until the information is no longer required and final disposition is ordered by the laboratory project manager in consultation with EPA or SulTRAC.

QAPP WORKSHEET #27 (CONTINUED) SAMPLE CUSTODY REQUIREMENTS

Sample Identification Procedures:

Properties will be identified using a unique sample ID number. The identifier will have the following format:

Street – sequential number – yard/quadrant – depth – sample type

Sample identifiers will consist of the first three letters or numbers of a street name (e.g., DRU for Drummond, 151 for 151st Street); a sequential property number will follow (e.g., “1000” for the first sample collected); a yard or quadrant designator (“F” for front yard facing street, “B” for back yard, and “NW, NE, SE, or SW” for quadrants); a depth designator (“0 – 6” for zero to 6 inches bgs), and a sample type (i.e. FD-field duplicate). For example, a sample collected from 12 to 18 inches bgs in the back yard at 4856 Drummond Street which is the 231st sample collected by the sample team would be designated as DRU231-B-12-18. The sample date and time will be recorded in field notebooks and on chains-of-custody forms. Sample team 1 will begin sequential numbering at “1000” and sampling team 2 will begin their sequential numbering at “5000” to prevent duplicating sample numbers.

CLP Scribe™ software will also assign each laboratory sample an ID number. Scribe was developed to expedite sample documentation, track samples from the field to the laboratory, and reduce the most common documentation issues associated with sampling. Before or during the sampling event, the user will enter information regarding the site, project, sampling team, analysis, location, matrix, collection time and date, and sample and tag numbers.

When the laboratory receives a sample shipment, its LIMS will generate the in-house identification numbers in accordance with its sample receipt and chain-of-custody SOPs.

QAPP WORKSHEET #28
QC SAMPLES TABLE

(UFP QAPP Section 3.4)

Matrix	Soil
Analytical Group	Arsenic and Lead
Concentration Level	Multi-concentration
Sampling SOP	S-1, S-2
Analytical Method/ SOP Reference	A-2
Sampler's Name/ Organization	TBD/ SulTRAC
Analytical Organization	CLP Laboratory
No. of Sampling Locations	See Worksheet #18

QC Sample	Frequency/ Number	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1 per extraction batch of 20 samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. If sufficient volume is not available, reanalyze affected extracts	Laboratory Analyst	Sensitivity/ Contamination	No target compounds > QL
MS	1 per extraction batch of 20 samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. Otherwise, analyze laboratory control sample to see if problem is analysis or sample.	Laboratory Analyst	Accuracy/Bias	75-125 %R
Laboratory Duplicate	1 per extraction batch of 20 samples maximum	If sufficient volume is available, extract and reanalyze samples in affected batch. Otherwise, analyze laboratory control sample to see if problem is analysis or sample	Laboratory Analyst	Precision	<20% RPD
Serial Dilution	1 per extraction batch of 20 samples maximum	If original sample is greater than 50xMDL. %D<10%	If sufficient volume is available, re-extract and reanalyze samples in affected batch	Laboratory Analyst	If original sample is greater than 50xMDL: %D<10%

QAPP WORKSHEET #28 (CONTINUED)
QC SAMPLES TABLE

Matrix	Soil				
Analytical Group	Arsenic and Lead				
Concentration Level	Multi-concentration				
Sampling SOP	S-1, S-2				
Analytical Method/ SOP Reference	A-2				
Sampler's Name/ Organization	TBD/ SulTRAC				
Analytical Organization	CLP Laboratory				
No. of Sampling Locations	See Worksheet #18				
QC Sample	Frequency/ Number	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Interference Check Sample	1 per extraction batch of 20 samples maximum	±20% of the true value	Sample analysis must be terminated, the instrument calibrated and verified, followed by the re-extraction and analysis of samples	Laboratory Analyst	±20% of the True value
LCS	1 per extraction batch of 20 samples maximum	%R presented in Worksheet #12	If sufficient volume is available, re-extract and reanalyze samples in affected batch. Otherwise, analyze laboratory control sample to see if problem is analysis or sample.	Laboratory Analyst	70-130 %R

QAPP WORKSHEET #29
PROJECT DOCUMENTS AND RECORDS TABLE

(UFP QAPP Section 3.5.1)

Document	Where Maintained
Field notes/logbook	Project file (field data), SulTRAC offices
Chain of custody forms	Project file (laboratory data), SulTRAC offices
Laboratory raw data package	EPA for CLP laboratory data; project file (laboratory data)
Laboratory equipment calibration logs	EPA for CLP laboratory
Validated data	Project file (laboratory data), SulTRAC offices

QAPP WORKSHEET #30 ANALYTICAL SERVICES TABLE

(UFP QAPP Section 3.5.2.3)

Matrix	Analytical Group	Concentration Level	Sampling Location/ ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person, and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Soil	Lead and Arsenic	Multi-concentration	See Worksheet #18	A-2	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5
Soil	TCLP Lead and Arsenic	Multi-concentration	See Worksheet #18	A-2	21 days	CLP laboratory identified by EPA Region 5	CLP laboratory identified by EPA Region 5

Notes

Analytical SOPs listed in Worksheet #23

QAPP WORKSHEET #31
PLANNED PROJECT ASSESSMENTS TABLE

(UFP-QAPP Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organization)	Person(s) Responsible for Responding to Assessment Findings (Title and Organization)	Person(s) Responsible for Identifying and Implementing CAs (Title and Organization)	Person(s) Responsible for Monitoring Effectiveness of CAs (Title and Organization)
Field Sampling Technical Systems Audit (TSA)	One the first day of soil sampling, and sporadically under direction of SulTRAC PM/QA Officer.	Internal	SulTRAC	QA/QC Officer and/or Project Chemist John Dirgo, Robert Thompson	Richard Baldino, SulTRAC Project Manager	Emalee Doyle, SulTRAC Field Team Leader	Emalee Doyle, SulTRAC Field Team Leader

Notes

CA Corrective Action
PM Project Manager
QA/QC Quality Assurance/Quality Control
TBD To Be Determined.

QAPP WORKSHEET #32
ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

(UFP QAPP Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (Name, Title, Organization)	Timeframe for Response
Field Sampling Technical Systems Audit (TSA)	Technical Memorandum	Richard Baldino, SulTRAC Project Manager	24 Hours	Technical Memorandum	Richard Baldino, SulTRAC Project Manager	24 hours

Notes

CA Corrective Action

QAPP WORKSHEET #33
QA MANAGEMENT REPORTS TABLE

(UFP QAPP Section 4.2)

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Name, Title, Organization)	Report Recipient(s) (Title and Organization)
None				

**QAPP WORKSHEET #34
VERIFICATION (STEP D) PROCESS TABLE**

(UFP QAPP Section 5.2.1)

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain-of-custody forms	Chain-of-custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody form should be initialed by the reviewer, a copy of the chain-of-custody form should be retained in the project file, and the original and remaining copies should be taped inside the cooler for shipment.	Internal	Sample Custodian (TBD), SulTRAC
Field notes/ logbook	Field notes will be reviewed internally and placed in the project file. A copy of the field notes will be attached to the final report.	Internal	Richard Baldino , SulTRAC
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	CLP Laboratory
	All received data packages will be verified externally in accordance with the data validation procedures specified in Worksheet #35.	External	Robert Thompson, SulTRAC

QAPP WORKSHEET #35
VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

(UFP QAPP Section 5.2.2)

Step Iia/Iib	Validation Input	Description	Responsible for Validation (Name, Organization)¹
Iia	Chain of custody	Examine traceability of samples from sample collection to sample analysis	EPA (CADRE), Analytical Coordinator, SulTRAC
Iia	Holding time	Confirm that holding time requirements are met	EPA (CADRE), Chemist, SulTRAC
Iia	Instrument calibration	Confirm that instrument calibration requirements are met	EPA (CADRE), Chemist, SulTRAC
Iia	Analytical method	Confirm that analytical methods specified in QAPP have been used for sample analysis	EPA (CADRE), Chemist, SulTRAC
Iib	Performance criteria	Confirm that QC samples meet specified performance criteria; document any deviations in data evaluation summary report	EPA (CADRE), Chemist, SulTRAC

Notes.

- 1 EPA is responsible for conducting computer-aided data review and evaluation (CADRE) of analytical data generated by the CLP laboratory. EPA data validation and review will be conducted by ESAT in accordance with CLP National Functional Guidelines (NFG) for Inorganic Superfund Data Review (EPA 2010)

QAPP WORKSHEET #36
VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE

(UFP QAPP Section 5.2.2)

Step Iia/Iib	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (Title and Organization)¹
Iia	Soil	Arsenic and Lead	Multi	CADRE criteria and NFG	CADRE validation (EPA) and review of case narrative by SulTRAC

Notes

¹ EPA is responsible for conducting computer-aided data review and evaluation (CADRE) of analytical data generated by the CLP laboratory. EPA data validation and review will be conducted by ESAT in accordance with CLP National Functional Guidelines (NFG) for Inorganic Superfund Data Review (EPA 2010).

QAPP WORKSHEET #37 USABILITY ASSESSMENT

(UFP QAPP Section 5.2.3)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: A team of SulTRAC personnel will perform the data usability assessment. SulTRAC's project manager will be responsible for information in the usability assessment. The project manager will also be responsible for assigning task work to the individual task members who will be supporting the data usability assessment. Note that the data usability assessment will be conducted on validated data. The results of the data usability assessment will be presented in the final project report.

Precision – Results of laboratory duplicates will be presented separately in tabular format. For each duplicate pair, the RPD will be calculated for each analyte whose original and duplicate values are both greater than or equal to the QL. The RPDs will be checked against the measurement performance criteria presented in Worksheet #12. The RPDs exceeding criteria will be identified in the tables. Additionally, the RPD of each analyte will be averaged across all duplicate pairs whose original and duplicate values are both greater than or equal to the QL, and the combined overall average RPD for each analysis will be calculated for the laboratory duplicates. A discussion will follow summarizing the laboratory precision results. Any conclusions about the precision of the analyses will be drawn, and any limitations on the use of the data will be described.

Accuracy/Bias – Results for laboratory method blanks and instrument blanks will be presented separately in tabular format for each analysis. The results for each analyte will be checked against the measurement performance criteria presented in Worksheet #12. Results for analytes that exceed criteria will be identified in the tables. A discussion will follow summarizing the laboratory accuracy/bias results. Any conclusions about the accuracy/bias of the analyses based on blank contamination will be drawn, and any limitations on the use of the data will be described.

Overall Accuracy/Bias – The results will be presented in tabular format to allow comparison of these results to the sample batch they apply to. These results will be compared to the requirements listed in Worksheet #12. A discussion will follow summarizing overall accuracy/bias results. Any conclusions about the overall accuracy/bias of the analyses will be drawn, and any limitations on the use of the data will be described.

Sensitivity – Results for all laboratory-fortified blanks will be presented separately in tabular format for each analysis. The results for each analyte will be checked against the measurement performance criteria presented in Worksheet #12 and cross-checked against the QLs presented in Worksheet #15. Results for analytes that exceed criteria will be identified on the tables. A discussion will follow summarizing the laboratory sensitivity results. Any conclusions about the sensitivity of the analyses will be drawn, and any limitations on the use of the data will be described.

Representativeness – The large numbers of samples collected are considered representative of site conditions, as long as completeness criteria in Worksheet #12 are met.

Comparability – The results of this study will be used as a benchmark for determining comparability for data collected during any potential future sampling events using the same or similar sampling and analytical SOPs.

Completeness – A completeness check will be performed on all data generated by the laboratory. Completeness criteria are presented in

QAPP WORKSHEET #37 (CONTINUED) USABILITY ASSESSMENT

Worksheet #12. Completeness will be calculated for each analyte as follows. For each analyte, completeness will be calculated as the number of data points for each analyte and individual matrix that meet the measurement performance criteria for precision, accuracy/bias, and sensitivity, divided by the total number of data points for each analyte. A discussion will follow summarizing the calculation of data completeness. Any conclusions about the completeness of the data for each analyte will be drawn, and any limitations on the use of the data will be described.

Describe the evaluative procedures used to assess overall measurement error associated with the project: NA

Identify the personnel responsible for performing the usability assessment: SulTRAC's analytical coordinator will review analytical data and the CADRE data review report to assess usability of the data. SulTRAC's project manager will review RPDs for samples and assess the overall usability of the data set in close consultation with the EPA WAM.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: The usability assessment will be documented in the data validation letter report, which will be generated 45 days after Phase 1 analytical results are received from the CLP laboratory.

Notes	
CLP	Contract Laboratory Program
EPA	Environmental Protection Agency
NA	Not Applicable
QL	Quantitation Limit
RPD	Relative Perfect Difference
SOP	Standard Operating Procedure
WAM	Work Assignment Manager

REFERENCES

- SulTRAC 2012a. "Remedial Investigation Report, US Smelter and Lead Refinery Superfund Site, Lake County, Indiana." June 20.
- SulTRAC 2012b. "Feasibility Study, US Smelter and Lead Refinery Superfund Site, Lake County, Indiana." June 20.
- SulTRAC 2014. "Work Plan for USS Lead Superfund Site, East Chicago, Lake County, Indiana." August 6.
- U.S. Environmental Protection Agency (EPA) 2002. EPA Guidance for Quality Assurance Project Plans. EPA QA/G-5. December.
- U.S. EPA 2003a. Superfund Lead-Contaminated Residential Sites Handbook. OSWER 9285.7-50. August.
- U.S. EPA 2005. Uniform Federal Policy for Implementing Environmental Quality Systems. March.
- U.S. EPA 2008. Hazardous Ranking System Documentation Record. US Smelter and Lead Refinery. April.
- U.S. EPA 2009. "Federal On-Scene Coordinator's Report, Rev. 1, Comprehensive Environmental Response, Compensation, and Liability Act Removal Action at the USS Lead Site, East Chicago, Lake County, Indiana, Site ID: 053J." August.
- U.S. EPA 2010. "EPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods, Multi-Media, Multi-Concentration, ISM01.3." January. On-line Address: <http://www.epa.gov/superfund/programs/clp/ism1.htm>
- U.S. EPA 2011. "Contract Laboratory Program Guidance for Field Samplers." January.
- U.S. EPA 2014. "RAC II Region 5 Statement of Work for Remedial Design (OU1), U.S. Smelter and Lead Residential Area Superfund Site." June 17.

FIGURES
(Two Sheets)

- **FIGURE B-1, SITE LOCATION MAP**
- **FIGURE B-2, USS LEAD RESIDENTIAL AREA ZONES**



ATTACHMENT A

STANDARD OPERATING PROCEDURES

SOP 001	Packaging, Shipping, and Custody of Samples, Revision No. 02. May 2013
SOP 002	General Equipment Decontamination, Revision No. 01. May 2013
SOP 005	Soil Sampling, Revision No. 2, August 2013
SOP XRF	EPA Method 6200: Field X-Ray Fluorescence Measurement, Number: SESDPROC-107IR2. Revision 2. December 2011

STANDARD OPERATING PROCEDURE (SOP) APPROVAL FORM

**SULLIVAN INTERNATIONAL GROUP, INC.
ENVIRONMENTAL SOP**

**PACKAGING, SHIPPING, AND CUSTODY OF SAMPLES
SOP NO. 001
REVISION NO. 02**

May 24, 2013

Merry Coons, P E , QA/QC Approved

5/24/2013
Date

1.0 PURPOSE AND SCOPE

Use of this Standard Operating Procedure (SOP) is critical to sample integrity. In this case, integrity is defined as the documentation and physical handling of a sample that allows the sample to be considered representative of an environmental medium at the time of collection. In a sampling program that meets the standard of care, the integrity of a sample is documented from its point and time of collection to its final disposition. Practices for classifying, packaging, and shipping samples are described in this SOP. Steps identified should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples.

When hazardous substances and dangerous goods are sent by common carrier, their packaging, labeling, and shipping are regulated by the U.S. Department of Transportation (DOT) Hazardous Materials Regulations ([HMR] Code of Federal Regulations, Title 49 [49 CFR] Parts 105 through 180) and the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR), Section 1.5. This SOP only addresses materials shipping and transport that are not considered dangerous goods. Procedures for packaging and shipping environmental samples not considered dangerous goods are discussed below.

This SOP establishes the requirements and procedures for packaging and shipping samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) "Sampler's Guide to the Contract Laboratory Program (CLP)," dated January 2011. There are small differences between the sample packaging for delivery to a CLP laboratory and for sample packaging for delivery to a commercial laboratory. This SOP notes where there are differences so that field staff will be informed of the proper procedures for the type of laboratory used. Sample packaging and shipping procedures described in this SOP should be followed for sample packaging and shipping. Deviations from the procedures in this SOP and the justification must be documented in a field logbook. This SOP assumes that samples are not dangerous goods and are already collected in the appropriate sample jars.

This SOP applies to sample custody, documentation, packaging, and shipping. The EPA regional Sample Management Office (SMO) is responsible for management, operations, and administrative support in the CLP.

This SOP applies to all Sullivan employees and employees of JV partner companies where Sullivan is the managing partner.

2.0 PROCEDURES

The procedures for packaging and shipping samples that are not considered dangerous goods require the following:

- Coolers
- Ice

- Bubble wrap or equivalent cushioning material
- Chain-of-custody forms and seals
- Airbills
- Resealable plastic bags for sample jars and ice
- Packing tape
- Plastic trash bags to line the coolers prior to packing

The following procedures apply to packaging and shipping samples that are considered dangerous goods and samples that are not considered dangerous goods.

2.1 SAMPLE CUSTODY

Sample custody procedures are designed to ensure that sample integrity is maintained from collection to final disposition. A critical aspect of sound sample collection and analysis protocols is the maintenance of strict chain-of-custody procedures as described in this SOP. Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if it is (1) in the physical possession of the responsible party; (2) in view of the responsible party after being in their possession; (3) secured to prevent tampering; or (4) placed in a designated, secure area that is controlled and restricted by the responsible party.

Custody will be documented throughout all sampling activities on the chain-of-custody record for each sampling day. This record will accompany the samples from the site to the laboratory. All personnel who have custody of samples are required to sign, date, and note on the record the time when receiving and relinquishing samples from their immediate custody. Any discrepancies will be noted at this time. Samples will be shipped to subcontractor laboratories via overnight air courier or hand delivered. Any exceptions to this policy will be noted in the Project Sampling and Analysis Plan (SAP). Air Bills or bills of lading will be used as proof of custody during sample transport and will be retained as part of the permanent sample custody documentation. In some cases, samples may be hand delivered to the subcontractor laboratory. Hand delivery will be noted on the chain-of-custody (COC) form (Section 2.4). The subcontractor laboratory is responsible for sample custody after samples are received.

2.2 SAMPLE CLASSIFICATION

Prior to sample shipment, it must be determined if samples collected during a specific field investigation meet the definitions for dangerous goods. This determination is made by an individual trained in dangerous goods shipping procedures. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, IATA, then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that

material. If the composition of the collected sample(s) is unknown, and the project team knows or suspects that it is a regulated material (dangerous goods), the sample may not be submitted for air transport. If the composition and properties of a waste sample or highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport. In addition, the shipment of pre-preserved sample containers or bottles of preservatives (e.g., NaOH pellets, HCL, etc.) which are designated as dangerous goods by IATA is regulated. Shipment of nitric acid is strictly regulated. Consult the IATA Dangerous Goods Regulations for guidance. Dangerous goods must not be offered for air transport by any personnel except the dangerous goods shipment designee or other personnel trained and certified by IATA in dangerous goods shipment. If coolers are to be used to ship dangerous goods, the environmental samples should be a limited quantity of no more than 30 kg (66 pounds) per shipment. If the weight of the sample material is greater than 30 kg per shipment, then dangerous goods shipping standards must be followed.

2.3 PACKAGING ENVIRONMENTAL SAMPLES

Environmental samples, after being correctly containerized, should be labeled. If the samples are to be analyzed by a commercial (non-CLP) laboratory, then the commercial laboratory will provide sample container labels. If no other label is available, the Sample Label may be used (included in the Forms section of this SOP). The following information is required to be written on the label:

- Sample ID – Sample nomenclature should be taken from the Project Sampling and Analysis Plan (SAP).
- Sample Date – The date the specific sample was collected.
- Sample Time – The time the specific sample was collected.
- Location – The location of the sample collected. For example, this information may be a monitoring well identification or a soil boring identification.
- Preservative – If a preservative, such as hydrochloric acid, is used, the information should be included on the label to let the laboratory staff be prepared to safely handle the sample during analysis.
- Analysis – List the analysis(es) required for the sample collected.
- Name or initials of the person(s) collecting the sample.

The label for each CLP sample should contain the following information:

- Case Number – This is the number provided by the SMO that is site and sampling event specific. It must be on all samples so the CLP laboratory knows to which Superfund project it belongs.

- Station Location – This is usually the sample location, such as monitoring well MW-XXX or surface soil location SS-XXX.
- Sample Number – This is the CLP sample identification number provided by the regional SMO. It is unique to a sample location and is used to identify and track samples throughout the sampling and analytical processes.
- Sample Date – The date the specific sample was collected.
- Sample Time – The time the specific sample was collected.
- Analysis - List the analysis(es) required for the sample collected.
- Tag Number – This is the seven to eight character number on the pre-printed tags supplied by the Regional SMO.

Prior to submitting the samples to the laboratory, the following steps should be followed to properly package the samples. Additional steps for proper packaging of CLP samples are noted below.

- Seal all drain holes in the cooler, if any, to prevent any leaking if samples break or from ice melt.
- Place completed label on the sample container. Note: Soil samples collected for volatile organic analyses (VOAs) using a 40-ml glass vial should not have the printed labels attached to the 40-ml vials. These sample vials already have a label attached. The attached label will have a tare weight on it. This means that the vial with the label has been weighed on a laboratory grade scale. It is important that nothing except the soil sample is in, or on, the vial. Information from the label prepared in the field can be written on the already attached vial label. Insert the field printed label in the re-sealable plastic bag discussed in item 6 below.
- Use clear packing tape to cover the label. This protects it from moisture that might cause it to detach from the container.
- For CLP samples, attach the Sample Tag to the container. Information on the sample label should match the information on the Sample Tag.
- If the sample container is glass, wrap the labeled sample in bubble wrap.
- Place the sample in a re-sealable plastic bag; no more than one container per bag is recommended, but you can wrap 40 ml vials in bubble wrap and place two or three to a bag.

- Place the bagged sample in a cooler. It is recommended that the cooler be lined with a large plastic garbage bag before anything else is placed in the cooler to contain sample material in case on container breakage.
- If additional cushioning of the samples is required, use bubble wrap to keep the glass containers from breaking. Do not use vermiculite or cat litter as sources of packing material.
- Add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in re-sealable plastic gallon-sized bags to prevent the melted ice from leaking out. It is recommended that two gallon-sized bags of ice be placed on the bottom of the cooler beneath the samples and two gallon-sized bags of ice be placed on top of the packaged samples.
- A temperature blank (a sample bottle filled with tap water) should be included with the cooler.
- Seal the completed, and signed, chain-of-custody forms in a plastic bag, after removing the back copy, and tape the plastic bag to the inside of the cooler lid.
- If the cooler is to be returned, include instructions for returning the cooler with the chain-of-custody forms.
- Close the lid of the cooler and tape it shut by wrapping packing tape around both ends and hinges of the cooler multiple times.. (Note: Sampling is expensive and tape is inexpensive, so use much more tape than you think is necessary to keep the cooler securely closed during transport.)
- Place two custody seals on the cooler, ensuring that one covers the cooler lid and the other on a hinge on the back side of the cooler. Place clear plastic tape over the custody seals. *When Laboratory couriers are used to pick up coolers from the jobsite, this step is not applicable. If no other seal is available, the Sample Seal may be used (included in the Forms section of this SOP).*
- Place address labels on the outside of the cooler. *When Laboratory couriers are used to pick up coolers from the jobsite, this step is not applicable.*
- Ship samples overnight by a commercial carrier such as FedEx. *When Laboratory couriers are used to pick up coolers from the jobsite, this step is not applicable.*

2.4 TRAFFIC REPORTS/CHAIN-OF-CUSTODY FORMS FOR SHIPPING SAMPLES

The traffic report (TR), or COC form, is used as physical evidence of sample custody from the sample location to the analytical laboratory. It is a permanent record for each sample collected and transported.

For commercial laboratories, the laboratory will provide COC forms along with labels and containers as specified in their contract with Sullivan. If no other COC form is available, the Chain-of-Custody Record form may be used (included in the Forms section of this SOP). The COC form is completed by the sampler or designated sample custodian. If the laboratory provides pick up service, the laboratory courier signs the COC form and the Sullivan sampler retains a copy for the project records. If the samples are shipped by an express commercial carrier, such as FedEx, the COC form is enclosed in the cooler as discussed in Section 2.2 above.

For CLP laboratories, Scribe software is used to create the documentation, including the TR/COC form, for the samples. Samples should be grouped by laboratory receiving them. When the sampling event Case Number is assigned, laboratory assignments will be divided between inorganic analysis and organic analysis depending on the types of chemical analysis requested.

For CLP sample shipments to the laboratory(s), a TR must be completed for each sample cooler. Each sample cooler will contain the TR/COC form specific to the samples within the cooler. The TR will contain the following information:

- Date the samples are shipped.
- The carrier and carrier airbill number. Each cooler must have its own airbill – multiple coolers should not be sent under one airbill.
- The laboratory and the laboratory contact information to which the samples are shipped.
- The Case Number assigned to the sampling event must be on every TR/COC form. The laboratory will not know to which Case a particular sample shipment is assigned unless it is on the TR/COC form.
- Information on the sample labels and tags should be included on the TR/COC form including the organic or inorganic CLP sample identification number, analysis, station location, tag number, and the date and time sample was collected.
- In addition, the following information should be included on the TR/COC form:
 - matrix type and sampler's last name;
 - the collection method, e.g., grab, composite, etc.;
 - turnaround time;
 - preservative;
 - number of containers per CLP sample identification number; and
 - the corresponding inorganic or organic sample identification number depending on what the TR/COC form is transmitting, e.g., if you are shipping organic samples, then the corresponding inorganic sample identification number.

The Scribe software program automatically generates a Traffic Report number which should be included on the TR/COC form. If any samples are to be analyzed using a CLP Modified Analysis (MA), the sampler should indicate use of the MA by creating a new analysis within the Scribe Analysis table. The newly created analysis should contain the Modification Reference Number within the name assigned in the analysis.

2.5 OVERNIGHT OR INDEFINITE SAMPLE STORAGE

In some cases, samples that cannot be shipped immediately to a laboratory must be temporarily stored in a secure location or sample refrigerator/cooler until arrangements can be made for delivery. The Sample Custodian shall place samples in the designated location (samples and signed chain of custody record(s) in re-sealable bags) and secure the samples until their disposition is determined. A temperature blank must accompany samples stored for any duration that require cooling as a preservation technique.

GLOSSARY

Contract Laboratory Program: CLP is the USEPA's Superfund laboratory program that provides analytical services through a national system which is required to provide data of known and documented quality.

Custody seal: A custody seal documents that no tampering with the samples occurred after they have been packaged for shipping. A CLP custody seal is a tape-like seal pre-printed with a specific number provided by the USEPA Region of origin. A non-CLP custody seal is a tape-like seal either pre-printed with the commercial laboratory's information and/or with the sampler's initials and the date. The custody seal is placed across the cooler lid and considered part of the chain-of-custody process.

Dangerous goods: Dangerous goods are articles or substances that can pose a risk to health, safety, property, or the environment and which are shown in the list of dangerous goods or which are classified according to the regulations (Section 1.0) based on the latest IATA DGR manual.

Environmental samples: Environmental samples are specimens collected for laboratory analysis. Sampled media may include, but are not limited to, drinking water, groundwater and ambient surface water, soil, sediment, air, and biological (e.g., tissue or plant) specimens.

Hazardous Materials Regulations: The HMR are DOT regulations for the shipment of hazardous materials by air, water, and land; they are located in 49 CFR 105 through 180.

Hazardous substance: A hazardous substance is any material, including its mixtures and solutions, that is listed in Appendix A of 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity (RQ) listed in the appendix.

IATA Dangerous Goods Regulations: The DGR are regulations that govern the international transport of dangerous goods by air. The IATA DGR are updated annually and posted in September. The DGR are based on the International Civil Aviation Organization (ICAO) Technical Instructions (49 CFR 171.11). The DGR contain all of the requirements of the ICAO Technical Instructions and are more restrictive in some instances.

Modified Analysis: The Modified Analysis (MA) is an analytical method that is not considered routine under the CLP. This is established during the analytical services request process. A modified analysis to be performed by a specific analytical laboratory will receive a unique MA number. For example, if the Region submits Modified Analysis for an additional analyte, the laboratory assignment will include the Modification Reference Number, such as VOC by MA 1100.

Overpack: An enclosure used by a single shipper to contain one or more packages and to form one handling unit for convenience of handling and stowage. Dangerous goods packages contained in the overpack must be properly packed, marked, labeled and in proper condition as required by IATA regulations (the latest edition of the IATA DGR). For example, a cardboard box may be used to contain three fiberboard boxes to make handling easier and to save on shipping costs if the cardboard box meets the requirement for an outer box.

Sample Label: A record attached to sample containers to verify legal documentation of traceability.

REFERENCES

U.S. Department of Transportation, Transport Canada, and the Secretariat of Communications and Transportation of Mexico (DOT and others). 2008. "2008 North American Emergency Response Guidebook."

International Air Transport Association (IATA). 2011. "Guidelines for Instructors of Dangerous Courses."

IATA. 2011. "Dangerous Goods Regulations." 52nd Edition.

U.S. Environmental Protection Agency. 2011. "Sampler's Guide to the Contract Laboratory Program." Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/R-96/032. On-Line Address:
<http://www.epa.gov/oerrpage/superfund/programs/clp/guidance.htm#sample>

FORMS

Sample Label

Sample Information	
Sample ID	Sample Date
Location	Sample Time
Analysis	Preservative
Site	Sampled By

Custody Seal

Sampler.

Date

Chain-of-Custody Record No.

Page of 1

**2750 Womble Road, Suite 100
San Diego, California 92106
(619) 260-1432
Fax (619) 260-1421**

[illegible]

Signature	Name (Print)	Company Name	Date	Time
Relinquished by:				
Received by				
Relinquished by:				
Received by				
Relinquished by:				
Received by				
Relinquished by:				
Received by				
Turnaround Time/Remarks				

STANDARD OPERATING PROCEDURE (SOP) APPROVAL FORM

**SULLIVAN INTERNATIONAL GROUP, INC.
ENVIRONMENTAL SOP**

**GENERAL EQUIPMENT DECONTAMINATION
SOP NO. 002
REVISION NO. 01**

May 24, 2013

Richard Baldino, Author

5/24/2013
Date

Tessa McRae, Technical Review

5/24/2013
Date

Merry Coons, P E , QA/QC Approved

5/24/2013
Date

1.0 PURPOSE AND SCOPE

The purpose of this standard operating procedure (SOP) is to provide methods to be used for preventing, minimizing, or limiting cross-contamination of samples as well as for reducing or eliminating the transfer of contaminants to clean areas. All non-disposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples. This SOP is applicable to standard field investigation activities (i.e., soil, groundwater, surface water, and sediment sampling) and does not address personnel decontamination. Decontamination of specialized materials such as radioactive materials is not addressed in this SOP.

Decontamination method(s) can be selected based on site-specific conditions; therefore, this SOP is not intended to be used as a decision document. Rather, its intended use is as a supplement to the work planning process by providing procedures, current references, and options for decontamination of equipment.

The primary reference for this SOP is The EPA "Sampling Equipment Decontamination" *Environmental Response Team SOP #2006 (Rev. #0.0, 08/11/94)*.

This SOP applies to all Sullivan employees and employees of JV partner companies where Sullivan is the managing partner.

2.0 METHODS AND PROCEDURES

Gross contamination can be removed by physical decontamination procedures such as brushing, air and wet blasting, and high- and low-pressure water cleaning. Depending on the chemicals present, an acid rinse and/or a high-purity organic solvent rinse may be required to remove the chemical(s) of concern. The following general steps must be taken when decontaminating sampling materials and equipment:

1. Physical removal by brushing, air and/or wet blasting, and high- or low-pressure water cleaning.
2. Non-phosphate detergent wash.
3. Tap-water rinse.
4. Distilled/deionized water rinse.

****The following steps are optional; one or more may be specified in the project-specific Sampling and Analysis Plan (SAP)****

5. 10% nitric acid rinse (for decontamination of metals).
6. Distilled/deionized water rinse.
7. Solvent rinse (acetone is commonly used to remove trace organic contaminants).
8. Air dry (if solvent rinse is used).
9. Distilled/deionized water rinse (if solvent rinse is used).

Depending upon the type and size of the equipment needing decontamination, large galvanized wash tubs, stock tanks, children's wading pool, or buckets can hold wash and rinse solutions. All decontamination water generated must be containerized and disposed of according to Sullivan Environmental SOP No. 16, Investigation-Derived Waste Management, or the site-specific project plan.

The following procedures present specific information and procedures for decontaminating drilling and monitoring well installation equipment, borehole soil sampling equipment, water level measurement equipment, and general sampling equipment.

2.1 DECONTAMINATION OF DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT

All drilling equipment that is reused during the sampling process, such as drilling rods, must be decontaminated at a designated location onsite (if possible) before drilling operations begin, between borings, and at completion of the project. All permanent monitoring well casings, screens, and fittings are assumed to be delivered to the site in a clean condition, which must be verified by the field personnel. If a temporary stainless-steel well screen is used to collect grab groundwater samples by direct-push technology, the well screen must be decontaminated after each groundwater sample collection.

Various methods will remove the contaminants that adhere to the drilling equipment. Typically, the drilling subcontractor will use a physical approach to decontaminate the equipment. The following steps must be taken when decontaminating drilling equipment:

1. Pressure-wash the down-hole equipment with water to remove large particles of soil.
2. Wash equipment with a scrub brush or wire brush in a tap water or distilled water and non-phosphate detergent solution such as Liquinox[®] or Alconox[®].
3. Rinse the equipment with distilled water and pressure-wash a second time. Make sure that decontaminated rods are not placed together with contaminated rods.

2.2 DECONTAMINATION OF BOREHOLE SOIL-SAMPLING EQUIPMENT

The soil sampling equipment must be decontaminated after each sample as follows:

1. Prior to sampling, scrub the split-barrel sampler and sampling tools in a bucket using a stiff, long-handled scrub brush and Liquinox[®] or Alconox[®] solution.
2. Steam clean the sampling equipment over the rinsate tub and allow to air dry.
3. Place cleaned equipment in a clean area on plastic sheeting.
4. Containerize all wastewater.
5. Decontaminate all pipe placed down the hole as described for drilling equipment.

2.3 DECONTAMINATION OF WATER LEVEL MEASUREMENT EQUIPMENT

Field personnel must decontaminate the water level indicator sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures must be used:

1. Wipe the sounding cable and probe with a disposable soap-impregnated cloth or paper towel.
2. Rinse with distilled/deionized water.

2.4 DECONTAMINATION OF GROUNDWATER PUMPS

Field personnel must decontaminate the submersible pumps before inserting and after removing them from each well. All submersible water pumps used for groundwater sampling or well development must be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Maintain the same level of personal protective equipment (PPE) as was used for sampling.
3. To decontaminate a submersible pump, all of the following steps shall be followed as in addition to what is specified in the project-specific Field Sampling Plan (FSP):
 - a. Fill a clean bucket with tap water and sulfate-free detergent (i.e., Liquinox® or Alconox®). The bucket must be large enough to immerse the pump inlets in water.
 - b. Pump the tap water with sulfate-free detergent through the equipment.
 - c. Repeat with a second bucket containing only tap water.
 - d. Repeat with a third bucket containing only distilled/deionized water.

Note: *Do not use regular commercial grade soap in the pumps.*

2.5 DECONTAMINATION OF WATER QUALITY METERS

Field personnel must decontaminate the flow-through cells and the water-quality probes before and after using them at each well. The flow-through cells and associated probes must be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Maintain the same level of PPE as was used for sampling.

3. To decontaminate the flow-through cell, all of the following steps shall be followed in addition to what is specified in the project-specific FSP:
 - a. Liquinox® or Alconox® wash
 - b. Tap water rinse
 - c. Distilled/deionized water rinse
4. To decontaminate the water-quality probes that fit in the flow-through cell, all of the following steps shall be followed as specified in the project-specific FSP:
 - a. Liquinox® or Alconox® wash
 - b. Tap water rinse
 - c. Distilled/deionized water rinse

Note: *Do not use regular commercial grade soap in the cells or probes.*

2.6 DECONTAMINATION OF GENERAL SAMPLING EQUIPMENT

All non-disposable sampling equipment must be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Maintain the same level of PPE as was used for sampling.
3. To decontaminate a piece of equipment, some or all of the following steps shall be followed in addition to what is specified in the project-specific FSP:
 - a. Liquinox® or Alconox® wash
 - b. Tap water rinse
 - c. Distilled/deionized water rinse

****Optional steps as specified in the project specific SAP****

 - d. 10 percent nitric acid rinse (used only if samples are collected for metals analysis)
 - e. Distilled/deionized water rinse
 - f. Solvent rinse (HPLC grade acetone, hexane, or methanol; used only if samples are collected for organic analysis)
 - g. Allow the solvent to evaporate
 - h. Distilled/deionized water rinse
 - i. Place cleaned equipment in a clean area on plastic sheeting, allow to air dry, and wrap with aluminum foil
4. Containerize all wastewater.
5. Containerize all PPE generated during decontamination efforts as described in the site-specific project plan and Sullivan Environmental SOP No. 16, Investigation-Derived Waste Management.

GLOSSARY

Split-Spoon (or Split-Barrel) Sampler: Thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Thin-Wall Tube Sampler: Steel tube (1 to 3 millimeters thick) with tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods. A plastic catcher may be included inside the cutting shoe when sampling sandy soils to reduce sample loss.

REFERENCES

U.S. Environmental Protection Agency (EPA). 1994. "Sampling Equipment Decontamination."
Environmental Response Team SOP #2006, Rev # 0.0. August 11.

SOP APPROVAL FORM



**PROJECT-SPECIFIC
ENVIRONMENTAL STANDARD OPERATING PROCEDURE**

SOIL SAMPLING

SOP NO. 005

REVISION NO. 2

Last Reviewed: August 2013

A handwritten signature in black ink, appearing to read "John R. King".

Quality Assurance Approved

19 August 2013

Date

1.0 BACKGROUND

Soil sampling is conducted for three main reasons: for laboratory chemical analysis, laboratory physical analysis, or visual classification and field screening. These three sampling objectives can be achieved separately or in combination with each other. Sampling locations are typically chosen to provide chemical, physical, or visual information in both the horizontal and vertical directions. A sampling and analysis plan is used to outline sampling methods and provide preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening methods being used and the physical features of the area.

1.1 PURPOSE

Soil sampling is conducted to determine the chemical, physical, and visual characteristics of surface and subsurface soils.

1.2 SCOPE

This standard operating procedure (SOP) describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling, and describes ten soil sampling devices.

1.3 DEFINITIONS

Hand auger: Instrument attached to the bottom of a length of pipe that has a crossarm or “T” handle at the top. The auger can be closed-spiral or open-spiral.

Bucket auger: A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

Core sampler: Thin-wall cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

EnCore™ sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore™ samplers are used to collect soil samples with zero headspace, as required for volatile organic compound analysis. Each sample is collected using a reuseable “T” handle.

Spatulas or Spoons: Stainless steel or disposable instruments for collecting loose unconsolidated material.

Triér: Tube cut in half lengthwise with a sharpened tip that allows for collection of sticky solids or loosening of cohesive soils.

Trowel: Metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

Split-Spoon (or Split-Barrel) Sampler: Thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Thin-Wall Tube Sampler: Steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

Volatile Organics Analysis (VOA) Plunger: Disposable, plastic, single-use soil sample collection device for volatile organic compound sample collection.

1.4 REFERENCES

- U.S. Environmental Protection Agency. (EPA) 1984. “Soil Sampling Quality Assurance Users Guide.” EPA 600/4-84-043.
- EPA. 1980. “Samplers and Sampling Procedures for Hazardous Waste Streams.” EPA 600/2-80-018. January.
- EPA 1983. “Preparation of Soil Sampling Protocol: Techniques and Strategies.” EPA 600/4-83-020.
- EPA. 1987. “A Compendium of Superfund Field Operations Methods.” OSWER Directive 9355.0-14 (EPA/540/P-87/001).

EPA. 1991. "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells." March. EPA/600/4-89/034.

EPA. 1994. "Soil Sampling." Environmental Response Team SOP #2012 (Rev. #0.0, 11/16/94). <http://www.ert.org/products/2012.pdf>

EPA. 1996. SW-846, Method 5035, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples. December. <http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/5035.pdf>

1.5 REQUIREMENTS AND RESOURCES

Soil sampling requires the use of one or more of the following types of equipment:

- Spoons and spatulas
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore™ sampler
- VOA Plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment is also needed for various methods:

- Sample containers, labels, and chain-of-custody forms
- Logbook
- Tape for measuring recovery
- Soil classification information
- Wax or caps for sealing ends of thin-wall tube
- "T" Handles
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

2.0 SOIL SAMPLING PROCEDURES

This SOP presents procedures for conducting test pit, surface soil, and subsurface soil sampling. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in the following order: (1) volatile organics, (2) semivolatile organics, and (3) metals. Once the chemical samples have been containerized, samples for physical analyses can be containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the Unified Soil Classification System (USCS), should be recorded. Field tests such as head space analyses can also be conducted.

Soil samples for chemical analyses can be collected either as grab samples or composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon® pan, tray, or baggie. Refer to the site-specific Quality Assurance Project Plan (QAPP) for methodology for composite sample collection. Samples for volatile organics analysis should not be composited.

All soil samples collected should be packaged and shipped to the laboratories in accordance with SOP 019. All nondedicated or nondisposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002.

2.1 SOIL SAMPLE COLLECTION PROCEDURES

Soil samples can be collected as discrete samples for volatile organic compound (VOC) analysis using specialized equipment for preservation in the laboratory or in the field. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC analysis

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative samples due to loss of VOCs. To prevent such losses,

preservation with methanol or sodium bisulfite may be used to minimize volatilization and biodegradation. This preservation may be performed in the laboratory or in the field, depending on the sample collection methodology used. The specific sampling methodology will be specified in the project-specific QAPP or work plan.

Soil samples to be preserved in the laboratory are collected using SW-846 Method 5035. For samples preserved in the field, laboratories may perform low-level analysis (sodium bisulfate preservation) or high- to medium-level analyses (methanol preservation), depending on the project-specific QAPP.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

2.1.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for VOC analysis that are to be preserved at the laboratory shall be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be obtained using a reusable sampling handle (“T” handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the soil sample in the following manner for each EnCore™ sampler.

The EnCore™ sampler is loaded into the “T” handle with the plunger fully depressed. Press the “T” handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil. When the sampler is full, using the “T” handle, rotate the plunger and lock it into place. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or forcing soil against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated. Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler. Remove any surface soil from outside of the sampler and place in the foil bag provided with the sampler. Label the bag with sample location information. Typically, collect three EnCore™ samplers per sample location. Decontaminate the “T” handle between sample locations.

Using the EnCore™ sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore™ sampler.

After the EnCore™ samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours of collection.

2.1.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analysis using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods. If samples effervesce when placed in preservative, it is necessary to collect a sample unpreserved, in deionized water. In addition, an unpreserved sample for determination of moisture content must also be collected when collecting soil samples to be preserved in the field.

Methanol Preservation (High to Medium Level). Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40- to 60-milliliter (mL) glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade 3 methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable VOA plunger. The outside diameter of the coring device must be smaller than the inside of the sample bottle neck. To collect the sample, pull the plunger back to the required location, insert it into the soil to be sampled, push the coring device into the soil, extrude the soil sample into the methanol-preserved sample bottle, and cap the bottle tightly. Swirl the sample (do not shake) in the methanol to break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately.

Sodium Bisulfate Preservation (Low Level). Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be field-preserved using sodium bisulfate are collected using the same procedures described for methanol preservation.

2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analyses

Samples collected for non-VOC analyses may be collected as either grab or composite samples as follows. Using a sampling device, transfer a portion of soil to be sampled to a stainless steel bowl, disposable inert plastic tray, or baggie. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel. Thoroughly mix the soil to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close the containers. Place the sample containers immediately on ice.

2.2 TEST PIT AND TRENCH SOIL SAMPLING

Test pit and trench soil sampling is conducted when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. Prior to conducting any test pit or trench excavation with a backhoe, the sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles.

A test pit or trench is excavated by incrementally removing soil material with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel shall enter any test pit or trench excavation over 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 of the *Code of Federal Regulations* § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before entering the test pit, and the use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific Health and Safety Plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel shall direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe

operator shall set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator shall disengage the controls and signal to the sampler that it is safe to approach the bucket. The soil sample shall then be collected from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by the use of flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore™ sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

2.3 SURFACE SOIL SAMPLING

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet below ground surface (bgs). The sample depth, sample analyses, soil type, and soil moisture will also dictate the most suitable sampling equipment. Prior to sample collection, the sampling locations should be cleared of any surface debris such as twigs, rocks, and litter. The following table presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

Sampling Equipment	Effective Depth Range (feet bgs)	Operating Means	Sample Type
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
EnCore™ Sampler	Not Applicable	Manual	Disturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed
VOA Plunger	Not Applicable	Manual	Disturbed

The procedures for using these various types of sampling equipment are discussed below.

2.3.1 Hand Auger

A hand auger equipped with extensions and a “T” handle is used to obtain samples from depths of up to 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; determining the exact depth at which samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

2.3.2 Bucket Auger

A bucket auger, equipped similarly as the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when sampling stony or dense soil that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the collected soil is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

2.3.3 Core Sampler

A hand-operated core sampler (Figure 1), similarly equipped as the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

2.3.4 Shovel

A shovel may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

2.3.5 Trier

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

2.3.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless steel or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless steel trowel. Samples may be placed directly from the trowel into sample containers.

2.4 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling is accomplished in conjunction with borehole drilling, for soil sampling from depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation.

Subsurface soil sampling may be conducted using a drilling rig, power auger, or direct-push technology (DPT). Selection of sampling equipment depends upon geologic conditions and the scope of the sampling program. Two types of samplers used with machine-driven augers—the split-spoon sampler and the thin-wall tube sampler—are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP No. 002 (General Equipment Decontamination). Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from

unconsolidated soils. The procedures for using the split-spoon and thin-wall tube samplers are presented below.

2.4.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, determine the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. In noncohesive or saturated soil, a catcher or basket should be used to help retain the sample.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOA samples are to be collected, EnCore™ samplers or VOA plungers should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample (except for the top several inches of possibly disturbed material) is retained for analysis or disposal.

2.4.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After removal of the tube sampler from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if sample material can be retained by the tube sampler). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, VOA samples must be collected immediately after the tube sampler is withdrawn. EnCore™ samplers or VOA plungers should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. For physical sampling parameters, the tube is sealed using plastic caps. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

2.4.3 Direct-Push Technology Sampler

Geoprobe systems utilize DPT. In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT uses acetate or clear polyvinyl chloride (PVC) sleeves for collecting soil samples.

Upon retrieval of the sampling rod from the ground, the sample sleeve is extruded from the sampling rod. The sleeve is sliced lengthwise twice, to open the sleeve. Soil samples can be collected directly from the opened sleeve. If VOA samples are to be collected, EnCore™ samplers or VOA plungers should be filled with soil taken directly from the opened DPT sampler. Samples for other specific chemical analyses should be taken after the VOA sample has been collected. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample is retained for analysis or disposal.

FIGURE 1
HAND-OPERATED CORE SAMPLER

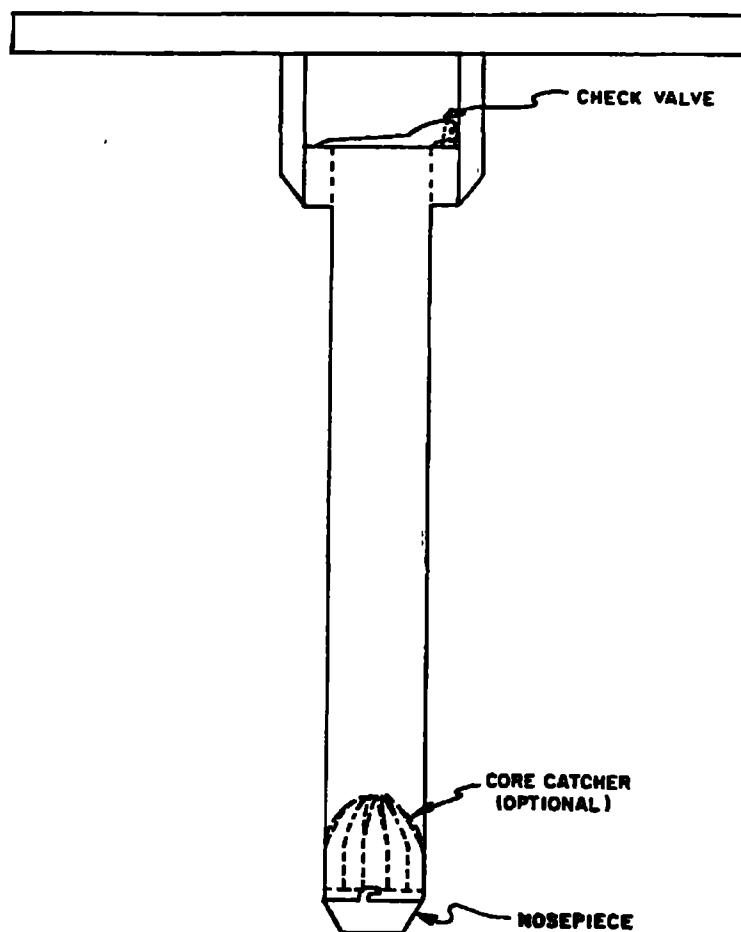


FIGURE 2

TRIER

TRIER

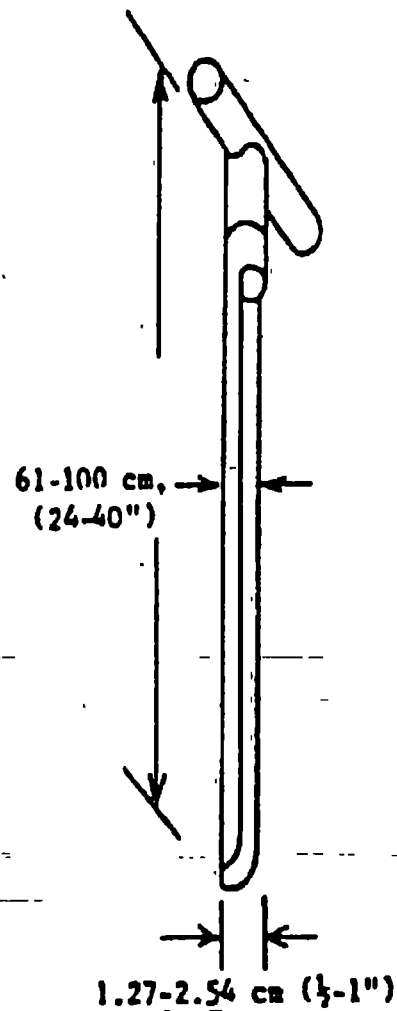


FIGURE 3
GENERIC SPLIT-SPOON SAMPLER

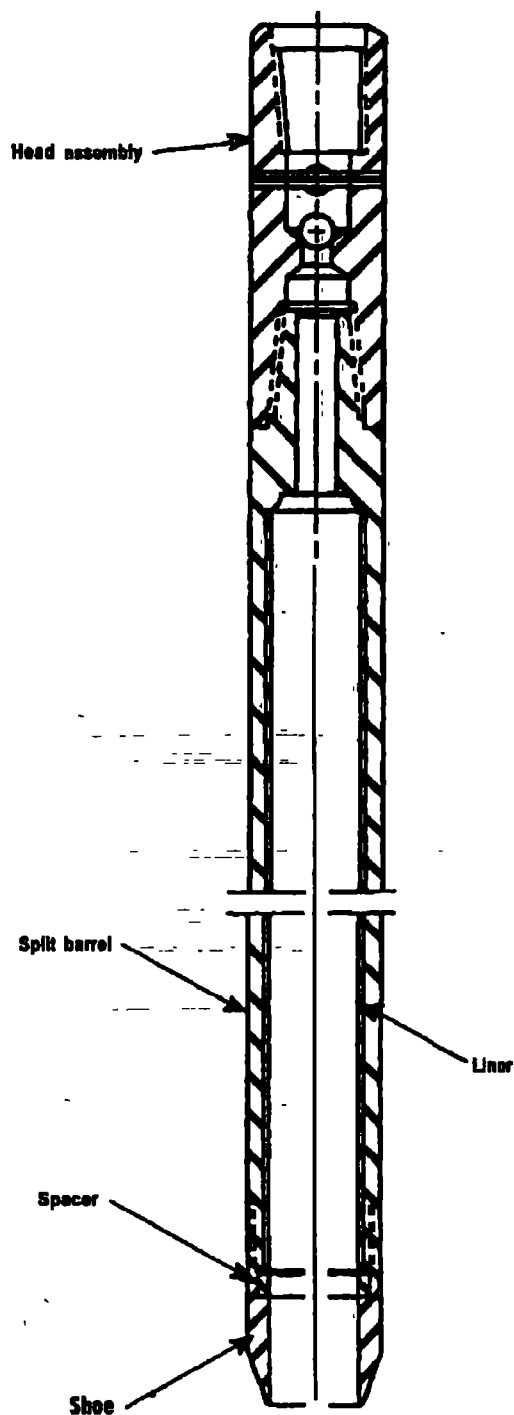
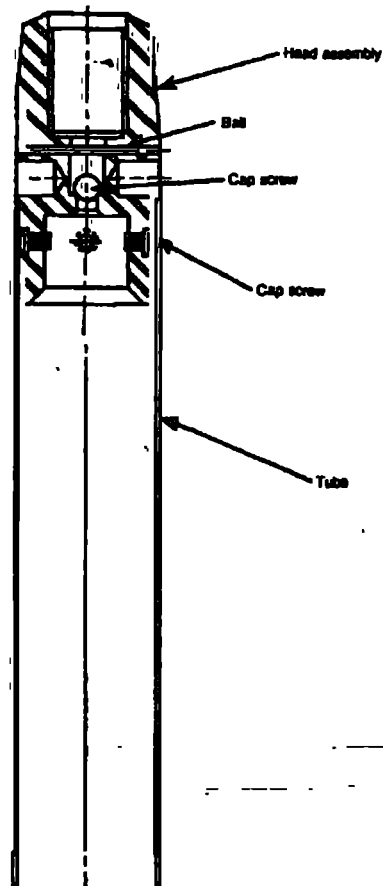


FIGURE 4
THIN-WALL TUBE SAMPLER



COPY

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: Field X-Ray Fluorescence Measurement

Effective Date: December 20, 2011

Number: SESDPROC-107-R2

Authors

Name: Donald Hunter

Title: Environmental Scientist, Regional Expert

Signature:

Donald Hunter

Date:

12/16/11

Approvals

Name: Archie Lee

Title: Chief, Enforcement and Investigations Branch

Signature:

Archie Lee

Date:

12/19/11

Name: Bobby Lewis

Title: Field Quality Manager, Science and Ecosystem Support Division

Signature:

Bobby Lewis

Date:

12/19/11

COPY

Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
<p>SESDPROC-107-R2, <i>Field X-Ray Fluorescence Measurement</i>, replaces SESDPROC-107-R1</p> <p>General: Corrected any typographical, grammatical and/or editorial errors.</p> <p>Title Page: Updated the Enforcement and Investigations Branch Chief to Archie Lee, and the Field Quality Manager to Bobby Lewis.</p> <p>Revision History: On the third sentence, replaced Field Quality Manager with Document Control Coordinator.</p> <p>Section 1.2: Added the following statement: Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.</p> <p>Section 1.3: Revised the last sentence to reflect that the official copy of this procedure resides on the SESD local area network (LAN), and that the Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN.</p> <p>Section 1.4: Deleted references to SOPs for old XRF units and added EPA Method 6200 reference.</p> <p>Section 1.5.1: Removed two bullets with material related to the R4 SESD Radiation Monitoring Program and old XRF units.</p> <p>Section 1.5.2: References to ILS being the only analyst were removed from the second and third sentences.</p> <p>Section 1.5.3: On bullet #4, Soil Moisture, removed reference to the use of microwave ovens for sample drying.</p> <p>Section 2: A reference to ILS being the only analyst was removed from the 2nd paragraph, first sentence. In addition, removed references to SOPs for old instruments and replaced with references to EPA Method 6200 throughout the section.</p> <p>Section 3.1: Removed references and associated text for old XRF units and replaced with references to Niton® XLt Series instrument.</p> <p>Section 3.2.2: Changed method name from “Cup” to “Collected Sample” Measurement.</p>	December 20, 2011

COPY

<p>SESDPROC-107-R1, <i>Field X-Ray Fluorescence Measurement</i>, replaces SESDPROC-107-R0</p> <p>General Updated referenced procedures due to changes in title names and/or to reflect most recent version.</p> <p>Title Page Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch.</p> <p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN.</p> <p>Section 1.4 Alphabetized and revised the referencing style for consistency.</p> <p>Section 2 Added last paragraph regarding stopping measurements due to environmental conditions.</p>	<p>November 1, 2007</p>
<p>SESDPROC-107-R0, <i>Field X-Ray Fluorescence</i>, Original Issue</p>	<p>February 05, 2007</p>

COPY

TABLE OF CONTENTS

1	General Information.....	5
1.1	Purpose.....	5
1.2	Scope/Application.....	5
1.3	Documentation/Verification	5
1.4	References	5
1.5	General Precautions.....	6
1.5.1	<i>Safety</i>	6
1.5.2	<i>Procedural Precautions</i>	6
1.5.3	<i>Limitations</i>	6
2	Operational Checks and Quality Control.....	8
3	Field X-Ray Fluorescence (XRF) Measurement Procedures.....	9
3.1	General	9
3.2	Mode of Operation	9
3.2.1	<i>In Situ Measurement</i>	9
3.2.2	<i>Collected Sample Measurement</i>	9
4	Study Design.....	11
4.1	General	11
4.2	Reconnaissance	11
4.3	Screening Support for Definitive Level Site Characterization	11

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when conducting field X-ray fluorescence (XRF) measurements of soil and sediment samples.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when measuring metals concentrations in soil, sediment or other solids in the field. On the occasion that SESD field personnel determine that any of the procedures described in this procedure cannot be used to obtain metals analyses of the media being sampled, and that another method or XRF instrument must be used to obtain said measurements, the variant instrument and measurement procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Sediment Sampling, SESDPROC-200, Most Recent Version

SESD Operating Procedure for Soil Sampling, SESDPROC-300, Most Recent Version

United States Environmental Protection Agency (US EPA). Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Method 6200, Revision 0, February 2007.

COPY

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA.

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SEDS, Athens, GA, Most Recent Version.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when conducting field XRF measurements. Refer to the SEDS Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, eye wear and gloves. The operator should always be aware of the instrument's radioactive source and the direction of its beam of X-rays. The operator should never point the open source at anyone. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

All field XRF measurements pertinent to the sampling event are recorded in a bound field record logbook for the event. This record is created and maintained by the analyst providing the field XRF support. After the investigation is complete, the analyst will conduct post-processing of the field measurements and will enter final measurement data in the SEDS laboratory information management system and provide the SEDS project leader with a copy of the field measurement logbook. All other records and documentation of the investigation should be recorded according to the procedures outlined in the SEDS Operating Procedure for Logbooks (SESDPROC-010).

1.5.3 Limitations

There are three main sources of interference in XRF analysis that may impact data quality. They are sample preparation error, spectral interferences and chemical matrix interferences.

- Preparation Error – The accuracy of the analysis is strongly impacted by sample homogenization. The more homogeneous the sample, typically analyzed by the cup method, the more accurate the results. There is no control of this limitation when conducting in situ analysis.

COPY

- **Spectral Interference** – Each element has a signature spectrum of energies and relative intensities. Many elements, however, produce X-rays of similar energy and discerning which element produced a detected X-ray is a factor of the detector's resolution capability and the software's ability to fit all of the data to the relative intensities produced by the various wavelengths.
- **Chemical Matrix Interference** – This refers to the effect that one element has on another in producing X-rays which reach the detector. Dominant elemental components of a sample, such as silicon in soils, vary in concentration from sample to sample and therefore so does that element's influence on the other elements in the sample.

There are several other limitations that the field investigator must be acutely aware of when conducting field analysis using XRF.

- **Soil moisture** – Excessive soil moisture biases the results low, i.e., the higher the soil moisture in a particular matrix, the lower the reported concentration relative to the actual concentration. This limitation may be overcome by drying the sample. Without sample drying, XRF measurement results for samples with typical soil moistures within the range of 15% - 25% are routinely reported at values less than laboratory confirmation analysis for the same samples. The actual difference may vary significantly for all samples from a site but the XRF results reported by the instrument are typically on the order of 70% - 80% of the laboratory reported value for samples in this moisture range. This factor should be taken into consideration when making decisions based on XRF results.
- **Lack of sensitivity with respect to certain analytes** – Due to peak overlaps, some analytes may have problematically high detection limits, i.e., detection limits may be higher than project action levels for certain analytes, limiting its use for rapid field screening for certain elements. One of the most common examples of this phenomenon is the lead/arsenic analyte pair. When lead and arsenic are being analyzed, the peak overlap problem results in detection limits for arsenic that are several times higher than the typical action levels published for this analyte. It commonly is necessary to perform confirmatory analysis in the laboratory to obtain analytical results for arsenic, or other analytes with high detection limits, to obtain data in the range necessary for making regulatory decisions.

2 Operational Checks and Quality Control

All XRF instruments shall be maintained and operated in accordance with the manufacturer's instructions, EPA Method 6200 and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Prior to each operational period, the instrument is turned on and is allowed to perform an internal calibration. Following this calibration, a performance check is conducted, using the appropriate National Institute of Standards and Technology (NIST)-traceable standard reference material for the analytes of concern. The value should be within +/- 20% of the stated value of the standard. Following this performance check, an instrument blank sample is analyzed to verify the instrument is not registering false positive results for the analytes of concern. After these checks, the instrument is ready for analysis.

The following operational and quality control requirements also apply to operation of the XRF instrument and must be followed and documented in the field logbook maintained by the analyst:

- During operations, the ambient air temperature will be recorded for each measurement and if the ambient temperature changes by more than 10°F, the instrument will be recalibrated.
- A method blank is analyzed at least once a day to determine if contamination is entering the analytical procedure.
- While the instrument is being used, the reference standards and the blank are run once each hour or every twenty samples, whichever occurs first, and also at the end of the period of operation, prior to turning the instrument off.
- For every twenty samples, or at least once per day, analyze a duplicate using the main sampling technique.
- Once per day, check the instrument's precision by analyzing one of the site samples at least seven times in replicate.

EPA Method 6200 contains detailed instruction and guidance covering implementation of these procedures and any corrective actions that must be taken based on measured instrument behavior and performance. If at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3. Field X-Ray Fluorescence (XRF) Measurement Procedures

3.1 General

XRF is the property of a material to emit X-rays, with a characteristic energy, upon being irradiated by X-rays from a known radioisotope source. The emitted X-rays are detected by the particular XRF instrument as they impact a detector, which converts the energy of the emitted X-ray into electric current. The strength of the current is proportional to the energy of the X-ray. An onboard microprocessor counts how often an energy is detected, assigns the energy to a particular element and reports the calculated concentration for the element.

The XRF instrument available for use by SESD field investigators is the Niton® XLt 700 Series Multi-element XRF Spectrum Analyzer. This instrument uses a miniaturized X-ray tube as its source rather than a radioactive isotope for X-ray generation for analysis.

3.2 Mode of Operation

The instrument is typically used in one of two modes, either for taking in situ measurements or for measuring sample-material that has been placed in a cup for analysis in the instrument tray. The following is a brief description of these modes of operation.

3.2.1 In Situ Measurement

Prior to taking the in situ measurement, the measurement location is cleared of any significant vegetation, such as large clumps of grass, and is scuffed or otherwise leveled to provide a flat surface on which to place the instrument window. A piece of thin Mylar® film is then placed on the measurement location. This protects the instrument window, preventing it from becoming damaged or contaminated by the media being tested. After the window is pressed to the Mylar® film, the window is opened for a nominal (i.e., programmed) sixty seconds.

Because of the shallow penetration of the X-rays in typical soils, the measured concentrations are representative of the concentrations present at the very surface of the material being measured. If conditions representing concentrations over a greater depth are required by the study data quality objectives (i.e., on the order of three to six inches), the cup method, described in Section 3.2.2, must be used.

3.2.2 Collected Sample Measurement

This method is used to measure concentrations of metals in soil and sediment samples collected from a vertical interval, either as a grab or a composite sample. Typically, soil or sediment samples are collected as if the samples were being collected for routine chemical analyses (SESD Operating Procedure for Soil Sampling (SESDPROC-300) and the SESD Operating Procedure for Sediment

COPY

Sampling (SESDPROC-200). After mixing, the media being sampled may be placed in either an 8-ounce glass container or a clean, unused zip-closure plastic bag (or equivalent). The XRF analyst then takes an aliquot from the container and places it in a small plastic cup with a Mylar® covering. The cup containing the sample is then loaded into a tray for analysis by the XRF instrument. Alternatively, if project objectives allow, measurements may be obtained by reading directly through the plastic bag. Window opening time considerations are the same as for the in situ measurement procedures described in Section 3.2.1.

The concentrations reported for the samples analyzed by the cup method are representative of the interval sampled, i.e., if the sampler collected the sample from the interval of 0 to 3 inches below ground surface, the reported concentration, assuming thorough homogenization, will be an average of the concentrations over that interval.

4 Study Design

4.1 General

XRF instruments are typically used for two main purposes. First it may be used to rapidly assess site conditions to support a site reconnaissance. Secondly, it may be used to screen large numbers of soil or sediment samples to minimize the number of samples that are sent to a laboratory to provide detailed site characterization data. These uses are summarized in the following sections.

4.2 Reconnaissance

XRF may be used to obtain *in situ* measurements at a large number of locations in a short period of time to determine if a site warrants further attention with respect to characterization. When used in concert with GPS, and when observing the limitations described in Section 1.5.3, XRF can reveal, where present, contamination patterns at a site which can form the basis for development of a more detailed study to provide definitive data for site characterization. Conversely, the reconnaissance results may form the basis for a “no further action” decision, providing a very cost effective tool for the decision maker.

4.3 Screening Support for Definitive Level Site Characterization

XRF may be used to supplement laboratory analyses to allow for the collection of large numbers of samples to provide a detailed characterization of a site. A high sample density grid or sampling pattern is created to provide adequate detail to meet the data quality objectives of the study or investigation. This sampling pattern may also involve the collection of significant numbers of subsurface soil samples to characterize any contamination present in the subsurface.

All samples, collected according to procedures found in SESD Operating Procedure for Soil Sampling (SESDPROC-300) and SESD Operating Procedure for Sediment Sampling (SESDPROC-200), are delivered to the XRF analyst on site. The analysis of these samples is conducted according to the method described in Section 3.2.2 of this procedure.

Based on the limiting factors described in Section 1.5.3, a confirmatory analytical scheme can be developed which minimizes the numbers of samples that must undergo laboratory analyses, yet provides definitive level data, with a high degree of confidence, to the project leader and other decision makers. Using the moisture limiting factor, there is usually a high degree of confidence that samples that screen at concentrations less than approximately 70% - 80% of the site action level will actually exceed the action level. Of the samples that screen *at* the action level, most all will, with a high degree of confidence, exceed the action level. If a reconnaissance is conducted prior to the full-scale site investigation, in addition to the *in situ* analysis, it is advisable to collect and

COPY

analyze a small subset of the screened locations to generate site-specific moisture limiting factors. This correlation factor can be used to develop a sampling scheme with more confidence.

Using these relationships, the following scheme may be implemented:

- Ten percent of the samples that screen at concentrations less than approximately 70% - 80% (or other correlation factor developed on actual data) of the site action levels are submitted for confirmation analyses to confirm that concentrations are, in fact, below the site action levels.
- All of the samples that screen at concentrations of 70% - 80% (or other correlation factor developed on actual data) of the action level up to the action level value are submitted for confirmation analyses to confirm that concentrations are, in fact, equal to or greater than the site action levels.
- Ten percent of the samples that screen at concentrations exceeding the action levels are submitted for confirmation analyses to confirm that concentrations are, in fact, greater than the site action levels.